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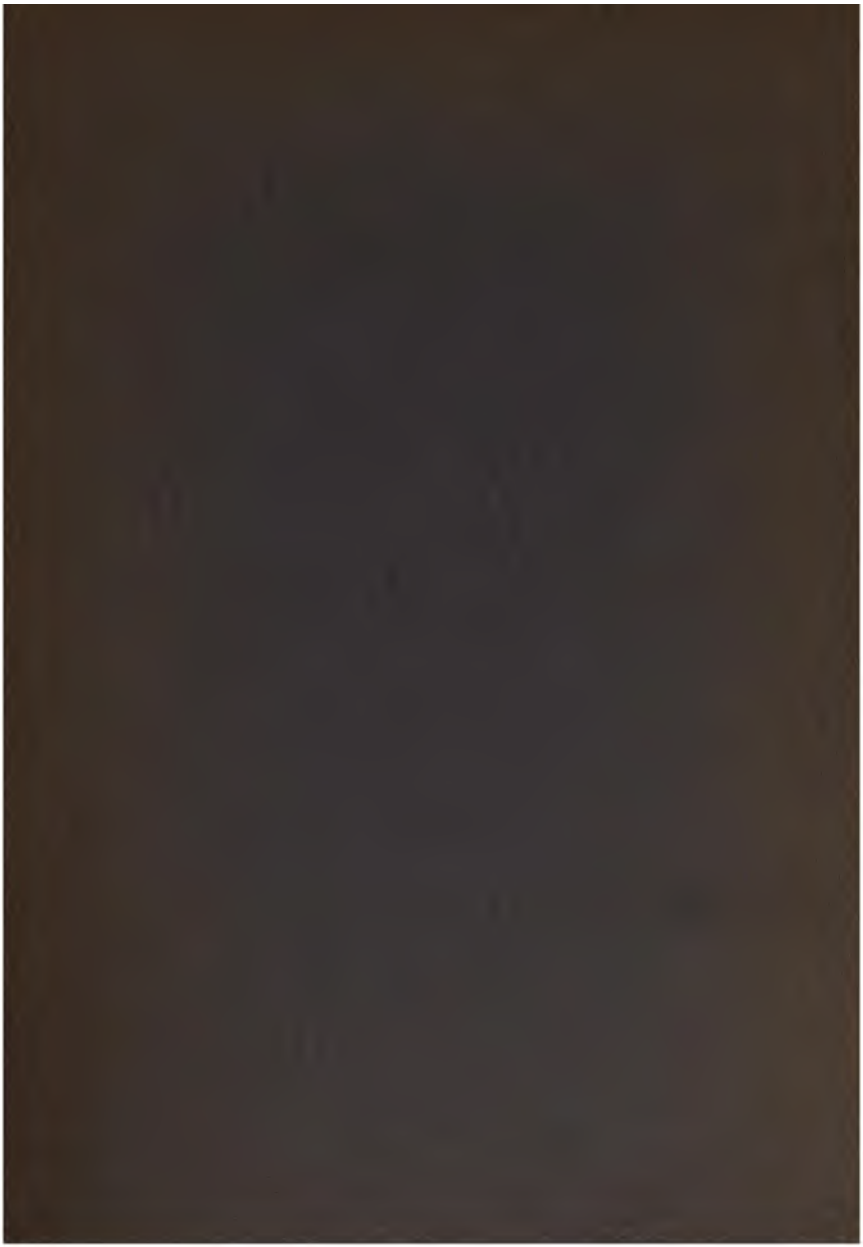

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ATTENDING PHYSICIAN BELLEVUE DISPENSARY, AND ATTENDING GYNECOLOGIST DEMILT DISPENSARY, NEW YORK.

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PREFACE.

THIS series is intended to aid medical students and practitioners in preparing to pass the State Board Examinations. The volumes are of the nature of neither text-books nor quiz compends. From the latter they differ materially in that they do not contain questions which *might* be asked, or which *ought* to be asked, or which, *if* asked, could be answered from some given text-book. They simply contain ALL the questions which *have been* asked and *are being* asked at the New York State Board Examinations, and they thus give an accurate idea of the scope of the examination and of the requirements of the examiners.

Although intended primarily for use by candidates preparing for the examinations held by the New York State Board, this volume will also serve as a guide for corresponding examinations conducted elsewhere, for a careful survey of the papers set in most of the other States will show a marked similarity to and almost monotonous repetition of the questions contained in this volume.

Students are advised to use this series as a companion to their text-books, to mark the questions they cannot answer and to learn the answers thereto, to write out in full all definitions, tables of composition, etc., and such other facts as they have found from experience are likely to be forgotten in the recitation room. For this purpose these volumes are

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arranged so as to leave right-hand pages blank and are printed on paper prepared for the use of either ink or pencil. Upon the eve of examination, students will find a review of the questions in these volumes, in connection with their personal notes, an efficient and ready means of preparation to successfully meet the test.

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Appended to each question is an indication of the dates upon which it has been asked, thus showing its frequency and relative importance.

The remaining volumes of this series are in active preparation, and will appear at an early date.

R. J. E. Scott.

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CHEMISTRY.

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The following abbreviations are used in the succeeding pages:

et seq. = and following (page or pages).
sub voce = under the word (or article or heading).
Q = question.
A = answer.

CHEMISTRY.

I. SPECIAL CHEMISTRY.

A. INORGANIC CHEMISTRY.

1. Hydrogen. Oxygen. Compounds of Hydrogen and Oxygen.

1. (a) *How does hydrogen exist in nature?* (b) *Give the symbol, valence, and atomic weight of hydrogen.* (*September, 1902.*)

2. (c) *Write chemical equations, showing two methods of obtaining hydrogen.* (*September, 1895.*)

3. (d) *Give a full description of a method of preparing hydrogen. Give the formulas and equation.* (*April, 1894.*)

4. (d) *How would you prepare hydrogen?* (*January, 1892.*)

5. (d) *How would you prepare hydrogen?* (*September, 1892.*)

6. (d) *Describe a method of preparing hydrogen.* (e) *Mention the properties of hydrogen.* (*April, 1898.*)

7. (d) *Describe a process for generating hydrogen.* (e) *What are the properties of hydrogen?* (*May, 1899.*)

8. (d) *Describe the preparation of hydrogen by the action of sulphuric acid on zinc, giving the equation.* (e) *Give the physical and chemical properties of the gas.* (*November, 1894.*

9. (e) *Describe the properties of hydrogen and* (f) *mention a test to prove that it will not support combustion.* (*May, 1893.*)

1 to 9. (a) Simon's Manual of Chemistry, page 116; (b)

page 109, valence, univalent; (c) Simon's Manual of Chemistry, page 117; (d) page 117, experiment 2.

$$Zn + H_2SO_4 + xH_2O = xH_2O + ZnSO_4 + H_2$$

(e) Simon's Manual of Chemistry, page 118; (f) Insert a lighted taper into a test-tube of hydrogen; the taper will be extinguished while the hydrogen will burn at the mouth of the test-tube with a very pale flame.

10. (a) *What is oxygen?* (*April, 1893.*)

11. Give (b) *the history,* (c) *occurrence in nature,* (d) *preparation,* (e) *physical and* (f) *chemical properties of oxygen.* (*January, 1897.*)

12. Describe oxygen as to (c) *occurrence,* (d) *preparation,* (e) *physical properties,* (f) *chemical properties,* (g) *office in the body.* (h) *Give the chemistry of the ordinary candle flame.* (*January, 1901.*)

13. (i) *Describe the production of oxygen by decomposition of potassium chlorate. Give the formulæ and equation.* (*January, 1894.*)

14. (d) *State a method of preparing oxygen.* (g) *What are the properties of oxygen which make it of use medicinally?* (*January, 1898.*)

15. (j) *Give a brief description of three experiments illustrating the properties of oxygen.* (*September, 1894.*)

10 to 15. (a) Simon's Manual of Chemistry, page 111 (occurrence); page 113 (properties), and add valence, (bivalent), symbol, and atomic weight; (b) Simon's Manual of Chemistry, page 111; (c) page 111; (d) page 111; (e) page 113; (f) page 114; (g) To maintain respiration, aerate the blood, oxidize the tissues, and thus supply heat and energy; briefly, to support life and combustion; (h) Simon's Manual of Chemistry, pages 140 and 141; (i) page 111; (j) 1. page 112, experiment 1; 2. Heat one end of a steel watch-spring to a bright redness, and thrust it into a jar of oxygen; it bursts into a scintillant flame. 3. Expose clean iron *scraps in oxygen for* some days; they become rusted.

16. Give the (a) *atomic weight,* (b) *atomic volume,* (c) *molecular weight,* (d) *molecular volume, and* (e) *density of oxygen. (May, 1895.)*

16. (a) 16; (b) 11.2; (c) 32; (d) 22.4; (e) 16.

17. (a) *Describe the medicinal uses of oxygen, stating* (b) *how it is brought to the bedside and how it is applied. (September, 1899.)*

18. (b) *Explain the manner of administering oxygen to a patient confined to bed. (June, 1900.)*

19. (c) *Where is oxygen found in the human body, and what are its important uses in the animal economy? (July, 1893.)*

17 to 19. (a) "The gas oxygen is now widely used in medical and surgical practice in three ways, as follows: By the inhalation of the gas itself from a cylinder in which it is compressed until forty gallons occupy a very small space; by drinking oxygen-water, which is distilled water saturated with the gas; and finally, by the use of the dioxide or peroxide of hydrogen, which is applied locally to diseased surfaces. Inhalations of oxygen are useful in the second and third stages of pneumonia;" in advanced bronchitis; for resuscitation of persons asphyxiated by coal-gas; in phthisis, anæmia, and leukæmia. When combined with ether or chloroform vapor the danger of the anæsthetic is decreased. (Hare, *Practical Therapeutics,* page 347.) (b) See (a); from the cylinder the oxygen is allowed to escape through a tube to which a funnel is attached, and this funnel is held near to the face of the person who is to inhale the oxygen; (c) See Q. 10 to 15 (g).

20. (a) *What is oxidation? (November, 1891.)*

21. (b) *Explain the process of combustion. (September, 1892.)*

22. (b) *What is* combustion? (c) *When and why is a flame produced by combustion. (January, 1900.)*

23. (d) What is the chemical cause of spontaneous combustion? (January, 1893.)

20 to 23. (a) Simon's Manual of Chemistry, page 114; (b) pages 114 and 346; (c) page 140; (d) "The combustion of oxygen and other substances always produces a definite amount of heat, depending upon the nature of the substance. When greasy rags or waste are thrown in a heap the heat produced by the oxidation of the oils may in time be sufficient to raise the mass to the temperature of ignition. This kind of action is known as spontaneous combustion." (Shepard's *Chemistry*.)

24. (a) *What is ozone?* (*November, 1891.*)

25. (a) *What is ozone?* (*June, 1892.*)

26. (a) *What is ozone?* (b) *How is it produced, and* (c) *what are its peculiar properties?* (*March, 1893.*)

27. (a) *What is ozone and* (b) *how is it prepared?* (*May, 1901.*)

28. (d) *Mention the chemical properties and* (e) *an allotropic modification of oxygen.* (f) *Give the use of oxygen and state its relation to animal life.* (*June, 1901.*)

29. (g) *Mention a test for ozone.* (b) *Explain how ozone may be prepared in the laboratory, and* (c) *compare its properties with those of oxygen.* (*November, 1893.*)

30. (b) *Give the method of preparation and* (c) *the special characteristics of ozone.* (*January, 1896.*)

31. Compare ozone with oxygen as to (h) *occurrence,* (c) *properties.* (*June, 1899.*)

24 to 31. (a) Simon's Manual of Chemistry, page 115; (b) page 115, and by the action of sulphuric acid on barium dioxide:

$$3BaO_2 + 3H_2SO_4 = 3BaSO_4 + 3H_2O + O_3$$

(c) Simon's Manual of Chemistry, page 115; (d) page 114; (e) ozone; (f) see Q. 10 to 15 (g); (g) Simon's Manual of Chemistry, page 115; (h) pages 115 and 111.

32. (a) *What is water, chemically considered?* (*November, 1892.*)

33. (b) *Give the composition of water by volume and by weight; its freezing point and* boiling point. (November, *1894.*)

34. (c) *How may water be decomposed? Illustrate.* (*May, 1895.*)

35. (c) *Describe the method of obtaining H and O by passing an electric current through* H_2O, *and* (d) *tell how to determine which gas is O.* (*July, 1893.*)

36. Describe some method for (c) *the analysis of water,* (e) *the synthesis of water.* (*May, 1899.*)

32 to 36. (a) Hydrogen monoxide, H_2O; a compound whose molecule consists of two atoms of hydrogen chemically united to one atom of oxygen;

(b)	By volume	2 of H and 1 of O
	By weight	2 of H and 16 of O
	Freezing point . . .	32° F. or 0° C.
	Boiling point . . .	212° F. or 100° C.

(c) Simon's Manual of Chemistry, page 67; (d) A glowing splinter of wood if immersed into the O will kindle and burn brilliantly; whereas, if immersed into the H, the splinter will be extinguished and the H will burn with a pale-blue flame; (e) Take a mixture consisting of two volumes of hydrogen and one volume of oxygen, pass an electric spark through this mixture; chemical union takes place with disappearance of the gases and production of water.

37. Give the general characteristics of rain-water, well-water, river-water, and lake-water. (*January, 1896.*)

37. "*Rain-water* is usually the purest of natural waters, so far as dissolved solids are concerned, containing very small quantities of the chlorides, sulphates, and nitrates of sodium and ammonium. Owing to the large surface exposed during condensation, rain-water contains relatively large quantities of dissolved gases—oxygen, nitrogen, and carbon dioxide; and sometimes hydrogen sulphide and sulphur dioxide. The absence of carbonates and the presence of nitrates and oxygen render rain-water particularly prone to dissolve lead, when in contact with that metal. In summer, rain-water is liable to become charged with *vegetable organic* matter suspended in the atmosphere.

"*Well-water* may be very good or very bad. If the well be simply a reservoir dug over a spring, and removed from sources of contamination, it has all the characters of fresh spring-water. If, on the other hand, it be simply a hole dug in the earth, the water which it contains is the surface water which has percolated through the thin layer of earth corresponding to the depth of the well, and is consequently warm, unaërated, and charged with organic impurity. Such water is sometimes called 'ground-water.'

"Wells dug near dwellings are very liable to become charged with the worst of contaminations, animal excreta, by their filtration through the soil, either by reason of the fracture of the house-drain or otherwise.

"*River-water* is a mixture of rain-water, spring-water, and the drainage-water of the district through which the river flows, to which snow-water, ice-water, or sea-water is sometimes added. The water of a river flowing rapidly through a granite region is, unless polluted by man, bright, fresh, and highly aerated. That of a stream flowing sluggishly through rich alluvial land is unaërated and rich in dissolved and suspended solids.

"The amount of dissolved solids in river-water increases with the distance from its source.

"The chief sources of pollution of river-water are by the discharge into them of the sewage of towns and cities, or of the waste products of factories.

"*Lake-water* is an accumulation of river and rain-water. As the waters of lakes are kept in constant agitation, both by the wind and by the current, they become to a certain extent purified from organic contamination." (Witthaus' *Manual of Chemistry.*)

38. What is meant by (a) *hard water?* (b) *soft water?* (*May, 1893.*)

39. Distinguish chemically between (a) *hard water and* (b) *soft water.* (*September, 1901.*)

40. What is meant by (a) *hard water*, (b) soft water? *What*

substances are found in such waters? (c) *Describe a filter.* (*May, 1902.*)

41. (a) *Define the term* hardness *as applied to a potable water.* (d) *What does the presence of an abnormal quantity of chlorine in a drinking-water indicate?* (*June, 1898.*)

38 to 41. (a) Hard water contains salts of magnesium or calcium in solution; and with difficulty lathers with soap. Hard water is of two kinds: 1. *Temporary hard,* when the bicarbonates of Mg or Ca are present in solution, and can be removed by boiling in water; 2. *permanently hard,* when the sulphate or other soluble salt of Mg or Ca is present, and cannot be removed by boiling the water; (b) Soft-water contains little or no mineral salts in solution, and readily lathers with soap; (c) Filters are of two kinds: one consists of a substance whose pores are too small for the particles it is desired to separate to pass through; the other variety depends for its efficiency upon the surface attraction of the particles of its substance for the substances in suspension. Of this latter class are sand and charcoal filters. A water-filter is best made of alternate layers of sand and charcoal in a vessel with inlet and outlet; water is allowed to flow slowly through the mass. (d) Simon's Manual of Chemistry, page 325.

42. (a) *Describe a test or the presence of organic matter in water.* (*January, 1893.*)

43. (a) *How may the presence of organic matter in water be recognized? Give a test.* (b) *Indicate a method for purification.* (*September, 1896.*)

44. (c) *Explain how water containing organic impurities may become purified by running in a shallow stream or over a precipice.* (*April, 1893.*)

42 to 44. (a) Simon's Manual of Chemistry, page 323; (b) Boiling and filtration; (c) It is thoroughly exposed to atmospheric oxygen, and dissolves a large quantity of the latter, which oxidizes its impurities. From these oxidation products it is in great part freed by their volatilization *or by precipitation.*

45. Describe (a) *distillation,* (b) *filtration, and* (c) *precipitation as applied to processes for purifying drinking water. (May, 1897.)*

45. (a) Distillation (Simon's Manual of Chemistry, page 36) consists in vaporizing the water and subsequently condensing it by means of cold, and then collecting. By this means water is obtained chemically pure; (b) Filtration [Q. 38 to 41 (c)] effects the separation of all particles of undissolved, suspended matter, without any alteration of such substances as are held in solution. It should be noted, however, that when charcoal is used it acts as a vigorous oxidizing agent by virtue of the oxygen contained in its pores; (c) Precipitation, as applied to hard waters, is designed to separate the excess of Ca salts and organic matter. It is accomplished in practice by the addition of a small amount of alum or ferrous sulphate, or aluminum hydroxide. Sedimentation or filtration follows this, in order to complete the separation.

46. (a) *What are mineral waters? (November, 1894.)*

47. Give a typical example of each of the following classes of mineral waters: (b) *saline cathartic,* (c) *alkaline,* (d) *sulphurous. (September, 1895.)*

48. (e) *To what salts do most cathartic mineral waters owe their virtue? (September, 1893.)*

49. State the characteristics of the following mineral waters: (f) *chalybeate waters,* (g) *bitter waters,* (h) *sulphur waters,* (i) *effervescent waters,* (e) *cathartic waters. (June, 1898.)*

46 to 49. (a) Simon's Manual of Chemistry, page 120; (b) Hunyadi Janos; (c) Vichy; (d) Harrowgate; (e) Sodium sulphate, magnesium sulphate; (f) Simon's Manual of Chemistry, page 120; (g) page 120; (h) page 120; (i) page 120.

50. (a) *What is peroxide of hydrogen? (May, 1893.)*

51. (b) *Describe the preparation of hydrogen dioxide, writing the reaction.* (c) *State the properties and* (d) *uses of hydrogen dioxide. (May, 1900.)*

52. Give (e) *the formula,* (d) *uses, and* (c) *properties of hydrogen dioxide.* (*September, 1900.*)

50 to 52. (a) Simon's Manual of Chemistry, page 122; (b) page 122; (c) page 122; (d) page 122; (e) page 122.

2. Fluorine. Chlorine. Bromine. Iodine.

53. (a) *What is fluorine and where is it obtained?* (b) *State the preparation and the practical uses of hydrofluoric acid.* (*January, 1896.*)

54. (b) *How is hydrofluoric acid prepared, and what are its uses?* (*September, 1897.*)

53 and 54. (a) Simon's Manual of Chemistry, page 172; (b) page 173.

55. (a) *Describe a method for the preparation of chlorine.* (*March, 1892.*)

56. (a) *Give the formulæ explaining the preparation of chlorine, in equation form.* (*January, 1892.*)

57. (a) *How and from what substances is chlorine prepared?* (*June, 1892.*)

58. (a) *How is chlorine obtained?* (b) *What are its properties?* (*November, 1894.*)

59. (b) *Mention the physical and chemical properties of chlorine.* (*June, 1893.*)

60. Give (b) *the physical properties of chlorine,* (c) *the commercial uses of chlorine.* (*January, 1900.*)

61. Give formulæ and equation of chemical action resulting in the production of (d) *hydrogen,* (e) *oxygen,* (a) *chlorine.* (*September, 1896.*)

62. (b) *Give the properties of chlorine.* (a) *State the source of chlorine, and* (f) *mention the most important of its compounds that are used in medicine.* (*May, 1898.*)

63. (a) *What is chlorine, and how is it produced?* (g) *How is chlorine administered medicinally through the mouth?* (*January, 1901.*)

64. (h) *Write a prescription for the administration through the mouth of chlorine gas dissolved in water.* (June, 1899.)

65. (i) *Upon what does the bleaching and disinfecting properties of chlorine depend?* (*November, 1891.*)

55 to 65. (a) Simon's Manual of Chemistry, pages 163 and 162; (b) page 164; (c) page 164; (d) page 117; (e) page 111; (f) Calx chlorata, hydrochloric acid, diluted hydrochloric acid, nitrohydrochloric acid, diluted nitrohydrochloric acid, ammonium chloride, chloroform, ethyl chloride, sodium chloride, potassium chlorate, mercurous chloride, mercuric chloride, aqua chlori, liquor sodæ chloratæ; (g) in the form of aqua chlori. Simon's Manual of Chemistry, page 164.

(h) ℞.—Aquæ chlori . . . . . ℥iij

Sig. Take one teaspoonful, well diluted, three times a day. Keep the bottle in the dark.

(i) Simon's Manual of Chemistry, page 164.

66. (a) *What acid contains chlorine as an important element?* (*January, 1892.*)

67. (a) *What acid contains chlorine as an important element?* (*September, 1892.*)

68. (b) *Write the formula for hydrochloric acid.* (*March, 1892.*)

69. Describe hydrochloric acid as to (c) *occurrence,* (d) *preparation,* (e) *physical properties,* (f) *chemical properties.* (*April, 1894.*)

70. Give (e) *the physical and* (f) *the chemical properties of hydrochloric acid.* (d) *How is hydrochloric acid prepared?* (*May, 1901.*)

66 to 70. (a) Hydrochloric acid; (b) Simon's Manual of Chemistry, page 165; (c) Found in the gastric juice of the mammalia, also in some volcanic gases; (d) Simon's Manual of Chemistry, page 165; (e) page 165; (f) page 165. It dissolves metals, with the formation of hydrogen.

71. (a) *Describe bromine.* (*July, 1893.*)

72. (b) *Name the principal sources of bromine.* (*January 1892.*)

73. Describe bromine, as to (b) *occurrence,* (c) *preparation, and* (d) *properties.* (*May, 1894.*)

74. Give (d) *the properties and* (e) *uses of bromine.* (*January, 1899.*)

75. (f) *State the properties and the uses in medicine of bromine and its salts.* (*September, 1900.*)

76. (c) *How is bromine prepared?* (g) *What important salts containing bromine are used in medicine?* (*June, 1898.*)

71 to 76. (a) Simon's Manual of Chemistry, page 168; (b) page 168; (c) page 168; (d) page 168; (e) page 169; (f) corrosive, poison, escharotic, and disinfectant. Its salts are cardiac and cerebral depressants, sedatives, hypnotics, and antispasmodics. The bromides are used in cases of nervous overexcitement; epilepsy; hysteria; nervous disturbances during pregnancy and the menopause; convulsions; satyriasis and nymphomania; acute laryngitis; the laryngeal crises of locomotor ataxia; insomnia; seasickness. (From Hare's *Practical Therapeutics.*) (g) bromides of ammonium, calcium, lithium, potassium, sodium, strontium, and zinc; also the hydrobromates of hyoscine and quinine.

77. Give (a) *the occurrence,* (b) *preparation,* (c) *properties,* (d) *important compounds, and* (e) *medicinal uses of iodine.* (*June, 1900.*)

78. (f) *Describe iodine.* (*January, 1893.*)

79. (g) *Write a synopsis of the chemistry of iodine.* (*September, 1896.*)

77 to 79. (a) Simon's Manual of Chemistry, page 170; (b) page 170; (c) page 170; (d) iodides of potassium, sodium, ammonium, and ethyl; mercurous and mercuric iodides; hydriodic acid. (e) Iodine is used in scrofulosis; enlarged lymph glands; fibroid phthisis; chronic bone disease; synovitis; lupus; chilblains; hydrocele. (From Hare's *Practical Therapeutics.*) (f) Simon's Manual of Chemistry, page 170; (g) page 170, and Q. 77.

80. Mention the properties of (a) *hydriodic acid,* (b) *hydrobromic acid. (September, 1902.)*

80. (a) Simon's Manual of Chemistry, page 171; (b) page 169.

81. Name and describe a test which you would apply to discover the presence of iodine. (June, 1892.)

81. Simon's Manual of Chemistry, page 171. Test 1. (Starch test.)

82. Give the names and the formulas of four *iodides commonly used in medicine. (June, 1896.)*

82.

Potassium iodide	KI
Sodium iodide	NaI
Ammonium iodide	NH_4I
Mercuric iodide	HgI_2

83. Mention the antidotes applicable in a case of poisoning from iodine. (June, 1894.)

83. Starch or farinaceous food mixed with tepid water, after emptying the stomach by emetics. The chemical antidote is a solution of sodium carbonate or bicarbonate. Morphine and amyl nitrite are also indicated. Sodium thiosulphate is also a chemical antidote.

84. What are bromids? Iodids? Chlorids? (November, 1894.)

84. Binary salts derived from the hydracids of bromine, iodine, and chlorine, respectively.

Thus:	KBr from	HBr
	NH_4I from	HI
	NaCl from	HCl

85. (a) *Mention the substances called halogens.* (b) *Why are they so called? (September, 1898.)*

86. (a) *Mention the halogens and* (c) *state in what respects they exhibit marked similarity. (April, 1898.)*

87. (d) *Give the names and symbols of three halogens.* (e) *Give a general description of* one *of the halogens mentioned. (September, 1901.)*

88. (d) *Give the name, symbol, valence, and* (f) *principal physical properties of each of the halogens.* (*May, 1900.*)

89. (f) *Compare the physical properties of chlorine, bromine, iodine, and fluorine.* (*April, 1895.*)

90. (e) *Describe the elements fluorine, chlorine, bromine, iodine.* (*June, 1896.*

85 to 90. (a) Simon's Manual of Chemistry, page 162; (b) From the Greek words ἅλς, sea-salt, and γεννάω, I produce; hence "salt producers," because they combine with metals to produce salts (like sea-salt); (c) Simon's Manual of Chemistry, page 162. (Note that the reference to page 65 should be page 99.) (d) Fluorine, Fl; chlorine, Cl; bromine, Br; iodine, I. They are all univalent; (e) Simon's Manual of Chemistry, pages 172, 162, 168 and 170; (f) pages 172, 164, 168 and 170.

3. Sulphur.

91. (a) *In what part of the body is sulphur found?* (*September, 1898.*)

92. (b) *Describe sulphur and* (c) *mention its important compounds.* (*June, 1897.*)

93. (d) *Describe the preparation and appearance of flowers of sulphur, roll sulphur, precipitated sulphur.* (*January, 1898.*)

94. (e) *Give the chemistry of sulphur.* (f) *How are sulphates detected?* (*May, 1902.*)

95. (g) *Describe the preparation of sulphur and* (h) *name the oxides of sulphur.* (*May, 1895.*)

96. (i) *When sulphur is burned in the air, what is the product and what are its uses?* (*July, 1893.*)

97. (j) *What are the physical and the chemical properties of* SO_2*?* (*April, 1896.*)

91 to 97. (a) Found in all parts of the body, being invariably a constituent of proteid matter; but it is most abundant in the hair, nails, and epithelium; (b) Simon's Manual of Chemistry, page 144; (c) pages 145 to 152; (d)

page 144 and 145; (e) page 144; (f) page 149; (g) pages 145 and 144; (h) sulphur dioxide, SO_2; and sulphur trioxide, SO_3; (i) sulphur dioxide, Simon's Manual of Chemistry, page 145; (j) page 145.

98. Is sulphurous acid a solid, a liquid, or a gas at ordinary temperature? (January, 1892.)

98. The official sulphurous acid (H_2SO_3) is a liquid containing sulphur dioxide in solution, Simon's Manual of Chemistry, page 146. (Sulphur dioxide, SO_2, often erroneously called sulphurous acid, is a gas.)

99. (a) *Write the formula for sulphuric acid. (November, 1891.)*

100. (b) *Write the graphic formula of sulphuric acid, representing S as a dyad. (January, 1902.)*

101. (c) *How can sulphuric acid be prepared? (March, 1892.)*

102. (c) *Give the method of manufacture of H_2SO_4. State* (d) *its properties and* (e) *uses. (January, 1895.)*

103. (c) *Describe a process for the production of sulphuric acid for commercial use. (September, 1896.)*

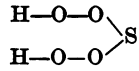
104. (c) *Explain the process of manufacturing sulphuric acid on a large scale. (September, 1897.)*

105. (c) *Give in detail the process of making sulphuric acid by the aid of heat and nitric acid. (April, 1899.)*

106. (f) *Give test for the presence of sulphuric acid as an adulteration of vinegar. (November, 1894.)*

107. (g) *Mention a chemical antidote for sulphuric acid, and explain the action of this antidote. (September, 1900.)*

99 to 107. (a) H_2SO_4;

(b)  ;

(c) Simon's Manual of Chemistry, page 148; (d) page 149; (e) It is used in the manufacture of sodium carbonate (Leblanc's process, Simon's Manual of Chemistry, page *188), artificial* fertilizers, nitroglycerin, and gun-cotton; in

the refining of petroleum; as a laboratory reagent. Its medical uses are: As a caustic for venereal sores, warts, and slowly-healing ulcers; internally in serous diarrhœa, cholera, acute lead poisoning, and for the night sweats of phthisis. (From Hare's *Practical Therapeutics.*) (f) Add some cane-sugar and evaporate; if the sugar turns black H_2SO_4 is present; (g) Simon's Manual of Chemistry, page 150; but omit the carbonate and the chalk, as they generate gas. Besides neutralizing the acid the magnesia and water convert it into an innocuous salt.

108. Name each of the following: (a) H_2SO_2; (b) H_2SO_3; (c) H_2SO_4; (d) $H_2S_2O_3$. (*May, 1894.*)

108. (a) Hyposulphurous acid; (b) sulphurous acid; (c) sulphuric acid; (d) thiosulphuric acid.

109. (a) *Give the name and formula of a compound of sulphur and hydrogen.* (*January, 1892.*)

110. (b) *What is sulphuretted hydrogen? Give its formula, properties, and uses.* (*September, 1896.*)

111. (c) *How is hydrogen sulphide formed in nature?* (d) *How is hydrogen sulphide prepared in the laboratory?* (*January, 1901.*)

112. (b) *What is hydrogen sulphide?* (e) *Show by formulas and equation how it is obtained by the action of hydrochloric acid on calcium sulphide.* (*April, 1897.*)

113. (c) *Give the occurrence in nature,* (d) *preparation, and* (b) *properties of hydrogen sulphide.* (*January, 1902.*)

114. (b) *What is the formula of sulphuretted hydrogen? What are some of its properties and uses?* (*June, 1894.*)

115. (d) *Describe the preparation and* (b) *state the properties of* H_2S. (*January, 1900.*)

116. (b) *Describe hydrogen sulphide.* (f) *Give a test for the detection of hydrogen sulphide.* (*May, 1902.*)

109 to 116. (a) Hydrogen sulphide; H_2S; (b) Simon's Manual of Chemistry, page 151; (c) page 151; (d) page 151;

(e) $CaS + 2HCl = CaCl_2 + H_2S$;

(f) *Simon's Manual* of Chemistry, page 152.

117. Discuss the value of sulphur as a germicide. (January, 1895.)

117. "Sulphur (dioxide, SO_2), though not so positive in its action as chlorine, is much more frequently employed on account of the lesser risk and trouble connected with it. It probably kills germs not containing spores if sufficiently concentrated and in the presence of moisture, and is, therefore, useful in the fumigation of rooms and of articles that cannot be subjected to steam heat or chemical solutions. But it will bleach or tarnish many articles, and for this reason and the fact that it is much inferior to formaldehyde, it will hereafter probably be almost entirely supplanted by the latter whenever that can be obtained. To secure sufficient concentration at least three pounds of sulphur should be burned for every 1000 cubic feet of air-space, care, of course, being taken that there may be no risk of igniting the floor or any articles in the room." (Egbert's *Hygiene and Sanitation*, page 310.)

4. Nitrogen. Phosphorus. Arsenic. Antimony.

118. Give the symbol, valence, atomic weight, and molecular weight of oxygen, hydrogen, and nitrogen. (April, 1896.)

118.

	Symbol.	Valence.	Atomic weight.	Molecular weight.
Oxygen	O	2	16	32
Hydrogen	H	1	1	2
Nitrogen	N	3	14	28

119. Describe one of the processes by which each *of the following may be prepared: HCl, O, N. (September, 1895.)*

119. Simon's Manual of Chemistry, pages 165, 111 and 124.

120. (a) *Mention the chief properties of nitrogen. (January, 1893.)*

121. Describe nitrogen as to (b) *importance,* (a) *properties,* (c) *occurrence.* (d) *State how to distinguish N from H. (June, 1900.)*

122. (a) *Describe nitrogen.* (b) *What is its importance in the free state? What is its importance in inorganic and in organic compounds?* (*April, 1897.*)

120 to 122. (a) Simon's Manual of Chemistry, page 124; (b) Free nitrogen serves as a diluent for atmospheric oxygen. Combined, it is an essential constituent of all protoplasm, animal or vegetable; also a constituent of ammonia, nitric acid, and their compounds, including the alkaloids; (c) Simon's Manual of Chemistry, page 124; (d) Hydrogen will burn with a steady, non-luminous flame if a lighted taper be applied to a jet of it, or to an open vessel containing it; nitrogen will not burn. And see Simon's Manual of Chemistry, page 119, beginning line 15. Also to the given gas add three volumes of hydrogen, mix, and pass an electric spark through the mixture. If the original gas were nitrogen, ammonia is formed, and can be distinguished by its odor; if the original gas were hydrogen, the result is negative.

123. (a) *What is the composition of the atmosphere?* (*November, 1892.*)

124. (a) *Name the constituents of the atmosphere.* (b) *Give the composition by weight and by volume.* (*April, 1895.*)

125. (a) *What is the composition of atmospheric air?* (c) *Give the percentage of each constituent.* (*January, 1896.*)

126. (a) *Give the composition of atmospheric air.* (d) *Define humidity of the atmosphere.* (*January, 1899.*)

127. (d) *What do you understand by the humidity of the atmosphere?* (*September, 1892.*)

128. (a) *What is the composition of atmospheric air?* (e) *Describe and state the uses of the thermometer, the barometer, and the hydrometer?* (*April, 1897.*)

129. (a) *Give the chemistry of the air.* (*January, 1902.*)

130. (f) *Is air a mixture or a compound? Explain.* (a) *Give the volumetric proportions of the constituents of the air.* (*June, 1902.*)

131. (f) Demonstrate the fact that air is a mixture and not a compound. (*July, 1893.*)

123 to 131. (a) Simon's Manual of Chemistry, page 125;

(b)

By weight	N	77
	O	23
By volume	N	79
	O	21

(c) Simon's Manual of Chemistry, page 125; (d) Humidity is the degree of saturation or the hygrometric state of the air. "The ratio of the quantity (of aqueous vapor) actually present, to that which it would contain if saturated, is known as the *degree of saturation* or *hygrometric state* of the air." (Martin and Rockwell's *Chemistry and Physics.*) (e) Simon's Manual of Chemistry, pages 36 and 26.

A hygrometer is an instrument for determining the absolute moisture of the atmosphere, or the degree of saturation. There are three varieties of hygrometers: the *chemical*, the *condensing*, and the *wet-bulb*.

"WET-BULB HYGROMETERS OR PSYCHROMETERS: These depend on the fact that most bodies evaporate more rapidly in dried air than in moist, and that in consequence of such evaporation their temperature falls. Two thermometers are placed on a wooden stand, and the bulb of one is covered with muslin, which is kept constantly moist, being connected with a reservoir of water by means of a string. Unless the air is saturated, the wet-bulb thermometer always indicates a lower temperature than the other. The percentage of saturation is calculated from the readings of the two thermometers, by the use of tables." (Martin and Rockwell's *Chemistry and Physics.*)

(f) "Proof that air is a mixture, and not a chemical compound: 1. The composition is not absolutely constant, as would be the case if it were a chemical compound. 2. When air is absorbed by water, then expelled, the ratio of the nitrogen and oxygen is not the same as in the original air. 3. Air produced by mixing proper quantities of oxygen and nitrogen is not attended by any chemical phenomena." (Martin and Rockwell's *Chemistry and Physics.)*

132. Describe (a) *the preparation,* (b) *properties, and* (c) *uses of ammonia.* (*June, 1896.*)

133. (a) *State how* NH_3 *may be prepared, and write the chemical reaction.* (*May, 1900.*)

134. (a) *Write a reaction for the preparation of* NH_3. (*June, 1901.*)

135. (a) *Give equation for the production of ammonia from ammonium chloride and calcium hydroxide.* (*September, 1894.*)

136. (d) *Give an equation showing the reaction when* NH_3 *comes in contact with an acid.* (*April, 1896.*)

137. (e) *What is* ammonia? (a) *Give the sources and* (c) *uses of ammonia in medicine and in the arts.* (*June, 1900.*)

132 to 137. (a) Simon's Manual of Chemistry, pages 127 and 126; (b) page 128; (c) Ammonia is used in the manufacture of ice, and in the preparation of the ammonium salts. "Ammonia is employed for four distinct purposes in medicine, namely, as a circulatory and respiratory stimulant, as a counterirritant, and as an antacid." (Hare's *Practical Therapeutics*, page 74.)

(d) $NH_3 + HCl = NH_4Cl$

$2NH_3 + H_2SO_4 = (NH_4)_2SO_4$

(e) Ammonia is a compound, NH_3, whose molecule consists of one atom of nitrogen chemically united to three atoms of hydrogen. See Simon's Manual of Chemistry, page 126. It combines with water to form ammonium hydroxide; it also combines directly with acids to form ammonium salts, without separation of hydrogen; see Q. 136.

138. (a) *Name* four *compounds of nitrogen and oxygen, and give their formulas.* (*May, 1896.*)

139. (b) *Write the chemical name and formula for laughing gas.* (*April, 1893.*)

140. (c) *Describe the preparation and* (d) *properties of nitrogen monoxide.* (*June, 1898.*)

141. (c) *Describe the preparation of nitrous oxide, writing the reaction.* (d) *State the properties* and use of nitrous oxide. (*September, 1900.*)

142. (e) *What is the difference between nitric oxide (NO) and air?* (*September, 1894.*)

138 to 142. (a) Simon's Manual of Chemistry, page 129; (b) Nitrogen monoxide, N_2O; (c) Simon's Manual of Chemistry, page 130; (d) page 131; (e) NO is a definite chemical compound, while air is a mixture. See Simon's Manual of Chemistry, pages 131 and 125; and Q. 130 and 131.

143. (a) *Give the formulas of the nitrogen acids.* (b) *How is nitrogen prepared in the laboratory?* (*June, 1901.*)

144. (c) *State the properties of nitric acid and* (d) *describe its preparation.* (*January, 1898.*)

145. (e) *Describe one of the processes by which each of the following may be prepared: Nitric acid, sulphuric acid.* (*June, 1894.*)

146. (f) *Give formula for nitric acid and show by equation how it is formed from the action of sulphuric acid on potassium nitrate.* (*May, 1894.*)

147. (f) *Show by equation how nitric acid is formed by the action of sulphuric acid on potassium nitrate.* (g) *How is nitric acid distinguished from the other mineral acids?* (*June, 1900.*)

148. (h) *What is the antidote for nitric acid poisoning?* (*June, 1899.*)

143 to 148. (a) Simon's Manual of Chemistry, page 132; (b) page 124; (c) page 132; (d) page 132; (e) pages 132 and 148; (f) HNO_3:

$$2KNO_3 + H_2SO_4 = K_2SO_4 + 2HNO_3$$

(g) Simon's Manual of Chemistry, page 134, tests; (h) page 134.

149. In what principal form is nitrogen eliminated from the human body? (*September, 1898.*)

149. As urea. CON_2H_4.

150. (a) *Give the occurrence in nature of phosphorus;* (b) *of chlorine.* (*September, 1894.*)

151. (a) State the occurrence in nature and (c) *give the properties of phosphorus.* (*May*, 1901.)

152. (c) *State the chemical properties of phosphorus.* (*April, 1895.*)

153. What are (c) *the properties,* (d) *allotropic modifications, and* (e) *uses of phosphorus?* (*January, 1897.*)

154. (f) *How may phosphorus be obtained?* (d) *Describe the allotropic forms of phosphorus.* (*June, 1898.*)

155. (g) *State the symbol, valence, atomic weight;* (c) *chemical properties, and* (h) *principal medicinal preparations of phosphorus.* (*September, 1897.*)

156. Describe phosphorus as to (a, f) *derivation,* (c) *properties,* (e) *commercial uses,* (i) *medicinal uses,* (h) *medicinal preparations.* (*September, 1900.*)

157. (j) *Give the chemistry of phosphorus.* (*June, 1902.*)

158. Give a description of phosphorus as to (a) *occurrence,* (c) *physical properties,* (i) *uses in medicine,* (k) *poisonous properties,* (l) *antidotes.* (*September, 1899.*)

159. (l) *What antidotes should be used in phosphorus poisoning? Why?* (*May, 1900.*)

160. (m) *How is phosphoric acid prepared?* (n) *What are the properties of phosphoric acid?* (*January, 1902.*)

150 to 160. (a) Simon's Manual of Chemistry, page 153; (b) page 162; (c) page 154; (d) page 155; (e) page 155; (f) page 153; (g) P, trivalent, 31; (h) Oleum phosphoratum, elixir phosphori, pilulæ phosphori, spiritus phosphori, zinci phosphidum, sodii hypophosphis, calcii hypophosphis, potassii hypophosphis, ferri hypophosphis, syrupus hypophosphitum, sodii phosphas, acidum phosphoricum dilutum. (i) "Phosphorus is useful in rhachitis and osteomalacia; in the sweats of general or nervous debility, nervous exhaustion, and in some cases of melancholia depending upon overwork. In the course of prolonged exhausting diseases, as typhoid fever or typhoid pneumonia, phosphorus is of service if the nervous system seems to be particularly affected." It is also used in morphinomania, in sexual exhaustion or abuse, in boils and carbuncles, and in acne indurata. (Hare's *Practical Therapeutics.)* (j) Simon's Manual of Chemistry, pages 153

to 156; and Q. 150 to 159; (k) page 156; (l) page 156; (m) pages 160 and 159; (n) page 160.

161. Discuss arsenic and mention its (a) *properties,* (b) *uses, and* (c) *compounds.* (*April, 1895.*)

162. Mention (d) *the chemical name,* (e) *properties, and* (f) *uses of white arsenic.* (*June, 1898.*)

163. (g) *What preparations of arsenic are most commonly used in medicine?* (*June, 1892.*)

164. (h) *Give the preparation of Fowler's solution and describe the salts contained in it.* (*January, 1900.*)

165. (e) *What are the chemical properties of arsenic?* (c) *Mention some of its principal compounds, giving formulas.* (i) *Give the chemical antidote.* (*September, 1896.*)

161 to 165. (a) Simon's Manual of Chemistry, page 253; (b) page 253; (c) pages 253 to 256; (d) page 253; (e) page 253; (f) page 254; (g) 1. Arsenic trioxide, also called arsenous acid. 2. Arsenic triiodide, also called arsenic iodide; from this is derived solution of arsenic and mercuric iodide, or *Donovan's solution.* 3. Potassium arsenite, the solution of which is called *Fowler's solution.* 4. Sodium arsenate, the solution of which is called *Pearson's solution.* (h) Simon's Manual of Chemistry, page 254. For the arsenous oxide see page 253. Potassium bicarbonate is crystalline, transparent, colorless, and odorless, with a saline taste; it is soluble in four parts of water, but nearly insoluble in alcohol. (i) Simon's Manual of Chemistry, page 261.

166. (a) *Describe a test for the detection of arsenic.* (*May, 1894.*)

167. (a) *Describe a method for detecting the presence of arsenic.* (*May, 1900.*)

168. (a) *Mention the most prominent test for arsenic.* (b) *What other element gives a similar test?* (c) *How are these elements differentiated?* (*May, 1902.*)

169. (a) *What is Marsh's test? Describe the apparatus employed and give the conduct of the experiment.* (*May, 1895.*)

170. (a) *How would you proceed to detect arsenic in a case of suspected poisoning?* (*May, 1893.*)

171. (d) *How should organic matter be treated for arsenic analysis, and* (a) *how should the test for arsenic be applied?* (*January, 1897.*)

172. (d) *Give in detail a test for arsenic in a mixture of food taken from the stomach.* (*January, 1899.*)

173. (e) *How would you conduct an autopsy for the purpose of testing for arsenic in the stomach and tissues?* (*January, 1894.*)

174. (f) *How may the presence of arsenic in wall-paper be detected?* (*November, 1894.*)

175. (g) *What treatment should be employed in arsenic poisoning?* (*September, 1896.*)

176. (g) *What is the chemical antidote for arsenic?* (*April, 1893.*)

177. (g) *Give the chemical antidote for poisoning from arsenic.* (*May, 1896.*)

178. (h) *What salt of iron is used as an antidote for arsenic poisoning? How may this salt be prepared rapidly?* (*January, 1898.*)

179. (i) *What is the chemical antidote for poisoning by arsenous acid? Explain its action.* (*April, 1897.*)

166 to 179. Learn Marsh's test. (a) Simon's Manual of Chemistry, page 259; (b) Antimony; (c) Simon's Manual of Chemistry, page 260; (d) page 261; (e) "It is not sufficient to send the stomach alone for analysis. The chemist should also receive the entire intestinal canal, at least one-half of the liver, the spleen, one or both kidneys, a piece of muscular tissue from the leg, the brain, and any urine that may remain in the bladder. The intestinal canal should be removed and sent to the chemist without having been opened, and with ligatures enclosing the contents at the two ends of the stomach and at the lower end of the intestine. *The brain* and alimentary canal are to be placed in *separate jars, and the* other viscera in another jar together; *the urine in a vial by* itself. All of these vessels are to be

new and clean and are to be closed by new corks, or by glass stoppers, or covers (not zinc screw-caps), which are then coated with paraffin (not sealing-wax), and so fastened with strings and seals that it is impossible to open the vessels without cutting the strings or breaking the seals." (Witthaus' *Manual of Chemistry.*) (f) See (d) and (a); (g) Simon's Manual of Chemistry, page 261; (h) Ferric hydroxide, $Fe_2(OH)_6$. It may be prepared rapidly by precipitating solution of ferric sulphate with magnesia.

Thus: $Fe_2(SO_4)_3 + 3MgO + 3H_2O = 3MgSO_4 + Fe_2(OH)_6$

Keep the two following solutions in separate bottles, and when needed mix them and administer:

1.	Liq. ferri tersulphatis . . .	℥ij.
	Aquæ	℥vj.
2.	Magnesiæ	℥iij
	Aquæ	℥viij.

(i) Ferric hydroxide. $Fe_2(OH)_6$. The ferric hydroxide changes the arsenic into ferrous arsenate, which is non-poisonous.

$$As_2O_3 + 2Fe_2(OH)_6 = Fe(OH)_2 + 5H_2O + Fe_3(AsO_4)_2$$

180. (a) *What are the properties of antimony?* (b) *How is it found in nature?* (*April, 1897.*)

181. What is the chemical antidote in case of poisoning by (c) *mineral acids;* (d) *tartar emetic?* (*July, 1893.*)

180 and 181. (a) Simon's Manual of Chemistry, page 262; (b) page 262; (c) Magnesia and water, or a solution of soap; (d) Simon's Manual of Chemistry, page 264.

5. Boron.

182. (a) *What is boron?* (b) *Give its principal compounds.* (c) *What is the chemical importance of boron in medicine?* (*June, 1897.*)

183. (d) *From what is boron obtained?* (b) *Mention* two *important compounds of this element.* (*May, 1898.*)

184. Mention the (e) *properties and* (f) *uses of boric acid.* (*June, 1902.*)

185. (g) *What are the constituent* parts of boroglyceride and (h) *what is its use in medicine?* (January, 1896.)

182 to 185. (a) Simon's Manual of Chemistry, page 142; (b) Boric acid, tetraboric acid, borax, boron trioxide, boroglyceride; (c) It is a chemical constituent of boric acid, also of borax; it is a valuable antiseptic; (d) Boron is obtained from boron trioxide B_2O_3 (which is itself obtained from boric acid); the B_2O_3 is decomposed by heating with Na, thus: $B_2O_3 + 3Na_2 = 3Na_2O + B_2$; (e) Simon's Manual of Chemistry, page 142; (f) Antiseptic, deodorant, disinfectant; dusting powder or surgical dressing; also used in solution as a lotion for many inflamed mucous surfaces, as in conjunctivitis, cystitis, etc.; (g) Boric acid and glycerin; (h) Antiseptic; application to nasal cavities, conjunctiva, and as boric acid; see (f).

6. Carbon.

186. (a) *State the properties of carbon.* (*January, 1902.*)

187. (a) *State the chemical properties of carbon.* (b) *Describe* two *allotropic forms of carbon.* (*May, 1899.*)

188. (c) *What is understood by allotropism?* (*March, 1893.*)

189. (c) *Define and give illustrations of allotropism.* (*June, 1894.*)

190. (d) *Mention two elements existing in allotropic modifications, and describe the modifications.* (*May, 1897.*)

191. (c) *Define allotropism.* (e) *Mention the allotropic forms of carbon and sulphur.* (*January, 1899.*)

192. (b) *Name the various forms of carbon.* (*March, 1892.*)

193. (b) *Name three different conditions in which pure carbon exists in nature.* (*January, 1893.*)

186 to 193. (a) Simon's Manual of Chemistry, page 135; (b) page 135; (c) page 103. For illustrations see pages 135 and 155; (d) Carbon, phosphorus, Simon's Manual of Chemistry, pages 135 and 155; (e) pages 135 and 144.

7. Iron.

194. (a) What is iron chemically? (b) *What preparation of iron is used in obtaining pharmaceutic preparations? (May, 1902.)*

195. (c) *Describe iron and its preparations.* (d) *Why is iron prescribed in anæmic conditions?* (*September, 1899.*)

196. (e) *What is reduced iron* (*ferrum reductum*), *and how is it obtained?* (*April, 1896.*)

197. (f) *How is ferric chloride made? Give the chemical equation.* (*January, 1899.*)

198. (g) *Give the names and formulas of the salts of iron commonly used in medicine.* (*May, 1899.*)

199. (h) *What are the general characteristics of the metals of the iron group?* (*April, 1893.*)

194 to 199. (a) A metallic, amphoteric element; and see Simon's Manual of Chemistry, pages 211 to 213; (b) Reduced iron (ferrum reductum); (c) Simon's Manual of Chemistry, pages 212 to 219. (d) Because iron is supposed to increase the amount of hæmoglobin in the blood (remember that hæmoglobin contains iron; see Simon's Manual of Chemistry, page 484); and also because if given in repeated doses it is said to cause an increase in the number of the red blood corpuscles. (e) Simon's Manual of Chemistry, page 214; (f) pages 215 and 216.

(g)	Ferrous sulphate	$FeSO_4$
	Ferrous carbonate	$FeCO_3$
	Ferrous iodide	FeI_2
	Ferrous lactate	$Fe(C_3H_5O_3)_2$
	Ferric chloride	Fe_2Cl_6
	Ferric nitrate	$Fe_2(NO_3)_6$
	Ferric hypophosphite . . .	$Fe_2(H_2PO_2)_6$

(h) Simon's Manual of Chemistry, page 211.

8. Aluminum.

200. (a) *State the properties of aluminum and* (b) *mention its important salts.* (*April, 1898.*)

201. (c) *What is the chemical composition of ordinary alum?* (*November, 1893.*)

202. (c) *Give the composition and* (d) *properties of common alum.* (*May, 1899.*)

203. (e) *Give the general characteristics of the aluminum group of elements.* (*September, 1895.*)

200 to 203. (a) Simon's Manual of Chemistry, page 206; (b) pages 206 to 208; (c) pages 207 and 206; (d) page 207; (e) They are trivalent, do not form acids, do form oxides and a few salts; their sulphates unite with the sulphates of the alkali metals to form alums.

9. Lead.

204. (a) *Give the symbol, atomic weight, valence, and physical properties of lead.* (*September, 1901.*)

205. (b) *What are the properties of lead?* (c) *What is litharge?* (d) *Give the toxicology of lead.* (*January, 1896.*)

206. Give (e) *the chemical and* (f) *the pharmaceutic name and* (g) *the formula of sugar of lead.* (*June, 1902.*)

207. (h) *What is the chemical antidote for poisoning from lead acetate?* (i) *Explain the chemical action of this antidote.* (*September, 1897.*)

208. (j) *Mention the objection to lead water-pipes. State the kind of water which, when used with these pipes, makes them specially dangerous.* (*July, 1893.*)

209. (k) *How may the presence of lead in water be detected?* (*April, 1896.*)

210. (k) *Describe a method of detecting the presence of lead salts in water.* (*September, 1900.*)

204 to 210. (a) Simon's Manual of Chemistry, page 232; (b) page 232; (c) Lead oxide, PbO; (d) Simon's Manual of Chemistry, page 234; (e) Lead acetate; (f) Plumbi acetas; (g) $Pb(C_2H_3O_2)_2+3H_2O$; (h) Magnesium sulphate; (i) It forms with the lead insoluble lead sulphate; (j) Simon's Manual of Chemistry, page 234; (k) page 234.

10. Bismuth.

211. (a) *Give the symbol, atomic weight, and the occurrence in nature of bismuth.* (*June, 1901.*)

212. (b) *To what impurity is the occasional toxic effect of bismuth salts due?* (*June, 1894.*)

211 and 212. (a) Simon's Manual of Chemistry, page 238.

Bismuth occurs free and also in combination with oxygen and sulphur; (b) To the presence of arsenic.

11. Lithium. Sodium. Potassium. Silver.

213. Describe lithium as to (a) *occurrence,* (b) *salts commonly used in medicine,* (c) *chemistry of its use in so-called rheumatic affections. (June, 1899.)*

214. (d) *Give the chemistry of lithium. (May, 1901.)*

213 and 214. (a) Simon's Manual of Chemistry, page 191; (b) The benzoate, bromide, carbonate, citrate, and salicylate of lithium; also lithia (lithium oxide); (c) It diminishes the acidity of the urine; is a diuretic; hastens the excretion of the urates and prevents the accretion of gravel; further, the *lithium* salt of uric acid is the most *soluble* of all the urates; (d) see Q. 213.

215. (a) *What is the most common salt of sodium? (January, 1892.)*

216. (a) *Give the formula and name of the most common salt of sodium. (September, 1892.)*

217. (b) *What is* common salt? (c) *State where and how common salt is obtained, and* (d) *give the chemistry of its use for freezing purposes. (January, 1901.)*

218. (e) *Give the names and formulas of* three *sodium salts. (January, 1899.)*

219. (f) *What is the composition of baking powders?* (g) *How are they adulterated?* (h) *What is their mode of action? (January, 1895.)*

215 to 219. (a) Sodium chloride NaCl; (b) Simon's Manual of Chemistry, page 187; (c) It occurs in nature chiefly as rock salt; in solution in sea-water and some mineral springs; (d) "The absorption of heat in the passage of bodies from the solid to the liquid state has been used to produce artificial cold. This is effected by mixing together substances which have an affinity for each other, one of which at least is a solid. Chemical affinity accelerates the *fusion, and the* portion which melts robs the rest of the *mixture of a large* portion of sensible heat, which becomes

latent. If the mixture cannot supply sufficient sensible heat, the latter will be absorbed from all surrounding substances. When ice is mixed with salt in the proportion of two parts of the former to one of the latter, the ice is rapidly melted, the rapid thaw involving a rapid disappearance of heat. If the mixture surrounds a liquid at the ordinary temperature, and if care is taken to prevent the ice from obtaining the necessary heat from other sources, the heat will be abstracted from the liquid, and in a short time its temperature will be so reduced that it will become frozen. The temperature obtained by the mixture of ice and salt, or snow and salt, is about 0° F." (Martin and Rockwell's *Chemistry and Physics.*) (e) Simon's Manual of Chemistry, pages 187 to 191; (f) Baking powders when pure should consist of cream of tartar, sodium bicarbonate, and a little flour; (g) Adulterations employed are alum, acid calcium phosphate, potassium chloride, ammonium carbonate; (h) It acts by the decomposition of the $NaHCO_3$ by cream of tartar, with sudden liberation of CO_2, minute bubbles of which permeate the dough and increase its porosity. The action may be represented by the equation:

$$NaHCO_3 + KHC_4H_4O_6 = NaKC_4H_4O_6 + H_2O + CO_2$$

220. (a) *Where does potassium occur?* (*January, 1892.*)

221. (b) *Describe potassium and* (c) *state its uses.* (*January, 1895.*)

222. (b) *Describe potassium.* (d) *Give the names of the principal salts of potassium used in medicine.* (*May, 1897.*)

223. (b) *State the properties of potassium.* (d) *Mention* ten *potassium compounds of importance in medicine.* (*September, 1898.*)

224. (d) *Name and give the formulas of* three *important salts of potassium used in medicine.* (*September, 1896.*)

225. (d) *Name and describe some of the more important potassium salts.* (*January, 1894.*)

220 to 225. (a) Simon's Manual of Chemistry, page 181; *(b) Potassium "is a* lustrous, silver-white metal, soft at the *temperature of the* air, plastic, and easily cut with a knife.

At 0° C. it is brittle and crystalline. Exposed to the air, it rapidly tarnishes on account of the formation of a thin film of oxide; thrown on water it instantly takes fire, liberating hydrogen and burning with a purple flame. It combines with non-metals, such as chlorine and sulphur, evolving heat and light." (Martin and Rockwell's *Chemistry and Physics.*) It melts at 62° C. and boils at a red heat; (c) Reducing agent in the laboratory; (d) Potassium acetate, carbonate, oxalate, tartrate, bitartrate, arsenite, bromide, bicarbonate, chlorate, chloride, citrate, cyanide, hydrate, iodide, nitrate, permanganate, sulphate; and see Simon's Manual of Chemistry, pages 182 to 185.

226. If potassium be thrown on water, what is the name and formula of the resulting compound? (April, 1895.)

226. Potassium hydroxide, KOH. See Simon's Manual of Chemistry, page 181.

227. What is the chemical difference between (a) *the chloride and* (b) *the chlorate of potassium? (June, 1892.)*

227. (a) KCl—a binary compound, derived from the hydracid HCl; (b) $KClO_3$—a ternary compound, derived from the oxyacid $HClO_3$. Further, KCl crystallizes in cubes, and is anhydrous. For $KClO_3$, see Simon's Manual of Chemistry, page 184.

228. (a) *Describe the preparation of iodide of potassium.* (b) *Give the reaction. (June, 1899.)*

229. (a) *How is potassium iodide prepared, and* (c) *what are its uses? (June, 1901.)*

228 and 229. (a) Simon's Manual of Chemistry, page 185; (b) page 185; (c) It is used medicinally in syphilis, subacute rheumatism, sciatica, lumbago, chronic pleurisy, pericarditis, hydrocephalus, aneurism, asthma, bronchial catarrh, pulmonary emphysema, cirrhosis of the liver, acute coryza, chronic interstitial nephritis, bronchocele, arterio-*sclerosis, and* enlargement of the cervical glands. (From *Hare's Practical Therapeutics.*)

230. Give (a) *the formula,* (b) *properties, and* (c) *uses of potassium permanganate.* (*May, 1902.*)

231. (d) *How does permanganate of potassium act as a disinfectant?* (*June, 1896.*)

232. (d) *What is the action of a solution of permanganate of potassium, used as a disinfectant?* (*June, 1902.*)

230 to 232. (a) Simon's Manual of Chemistry, page 222; (b) page 222; (c) page 222; (d) page 222.

233. (a) *Describe the element silver, stating* (b) *its compounds and* (c) *their uses in medicine.* (*May, 1896.*)

234. (d) *What method in most instances is available to reduce silver from its compound?* (*June, 1892.*)

235. (e) *What salt of silver is commonly used in medicine? Give its formula.* (*March, 1893.*)

236. (f) *Give the formula, preparation, and properties of nitrate of silver.* (g) *Mention a test for nitrate of silver.* (*September, 1902.*)

237. Mention the antidotes applicable in case of poisoning from (h) *silver nitrate;* (i) *sugar of lead.* (*September, 1893.*)

233 to 237. (a) Simon's Manual of Chemistry, page 241; (b) pages 242, 243, and add silver chloride, sulphate, carbonate, sulphide, and cyanide. (c) In medicine the nitrate is chiefly used; occasionally the iodide. The nitrate is used as a caustic, astringent, and stimulant for ulcers, inflammations, etc. Used also in gonorrhœa, gleet, ophthalmia neonatorum, tinea tarsi, gastric ulcer. (d) Simon's Manual of Chemistry, pages 240 and 241; (e) Silver nitrate, $AgNO_3$; (f) Simon's Manual of Chemistry, page 242; (g) page 243; (h) page 243; (i) page 234.

238. Name the elements in the potassium group and give their physical and chemical properties. (*May, 1896.*)

239. Name three elements in the potassium group. (*January, 1892.*)

238 and 239. Simon's Manual of Chemistry, pages 180 and 181. (Note that in the official syllabus silver is in*cluded in* this group.)

12. Ammonium.

240. (a) *What is ammonium?* (*April, 1893.*)

241. (b) *Give the composition of aqua ammonia.* (*May, 1893.*)

242. (c) *Give the preparation, formula, and characteristics of bromide of ammonium.* (*January, 1896.*)

243. (d) *State the composition, mode of preparation, and properties of sal ammoniac.* (*September, 1899.*)

244. (d) *Give the formula of ammonium chloride. Describe the method of preparing ammonium chloride.* (*May, 1901.*)

240 to 244. (a) Ammonium is a compound univalent radical, whose salts are formed by the direct union of an acid with ammonia NH_3. See Q. 136. (b) Simon's Manual of Chemistry, page 128. (c) page 194. Bromide of ammonium is found as small, colorless crystals, which turn yellow on exposure to the air, soluble in water and also (less readily) in alcohol; taste is pungent and salty. (d) Simon's Manual of Chemistry, pages 192 and 193.

$$NH_4OH + HCl = H_2O + NH_4Cl$$

13. Calcium. Barium. Strontium.

245. (a) *Give the symbol, occurrence in nature, physical properties and uses of calcium.* (*January, 1902.*)

246. (b) *In what compound is sodium most abundant?* (c) *In what calcium?* (d) *In what hydrogen?* (*March, 1893.*)

247. (c) *What is the formula of calcium carbonate?* (*June, 1892.*)

248. (e) *How is chlorinated lime made? What is the principal use of chlorinated lime?* (*September, 1898.*)

249. (f) *Give the flame test for barium and strontium.* (*June, 1894.*)

250. (g) *Name three metals of the alkaline earths, giving a compound of each with its formula.* (*January, 1897.*)

245 to 250. (a) Simon's Manual of Chemistry, pages 198 and 199. *Properties:* It is a metal, hard, yellow, ductile and malleable, and fuses at a red heat. *Uses:* Simon's Manual of Chemistry, pages 199 to 202. (b) NaCl; (c) $CaCo_3$; (d) H_2O; (e) Simon's Manual of Chemistry, page

202; (f) page 205; (g) 1. Calcium—calcium carbonate, $CaCo_3$. 2. Barium—barium, chloride. $BaCl_2$. 3. Strontium—strontium nitrate, $Sr(NO_3)_2$.

14. Zinc.

251. (a) *Give the names and the formulas of three compounds of zinc used in medicine.* (*May, 1897.*)

252. (b) *Give the properties of* two *important salts of zinc used medicinally.* (*April, 1898.*)

251 and 252. (a) Zinc oxide, ZnO; Zinc chloride, $ZnCl_2$; zinc sulphate, $ZnSO_4$; (b) see Q. 251, and Simon's Manual of Chemistry, pages 228 and 229.

15. Copper. Mercury.

253. What is Fehling's solution? (*November, 1891.*)

253. Simon's Manual of Chemistry, page 577 (last line).

254. Where do (a) *Na,* (b) *Hg, and* (c) *Cu occur in nature?* (d) *Which occur free?* (*April, 1894.*)

254. (a) Simon's Manual of Chemistry, page 187; (b) page 243; (c) page 234; (d) Hg, Cu.

255. (a) *Give the physical and the chemical properties of mercury.* (b) *How is mercury obtained from the native ore?* (*May, 1897.*)

256. (a) *Mention the properties of Hg, and* (c) *also two of its uses.* (*June, 1893.*)

255 and 256. (a) Simon's Manual of Chemistry, page 244; (b) page 243; (c) page 244.

257. Name two compounds of mercury and chlorine frequently used in medicine, and state how they may be distinguished from each other. (*November, 1893.*)

258. Give the names, formulas, solubility, and color of the two chlorides of mercury. (*September, 1899.*)

259. Give the formula for mercuric chloride (*corrosive sublimate*) *and mercurous chloride* (*calomel*). (*November, 1891.*)

260. Give the chemical formulæ for mercuric chloride

(corrosive sublimate) and that for mercurous chloride (calomel). (June, 1892.)

261. Distinguish the chemical as well as the physical properties of calomel and of corrosive sublimate. (June, 1895.)

262. Differentiate calomel and corrosive sublimate as to (1) *physical properties,* (2) *chemical properties. (September, 1896.)*

263. Give the chemical and the pharmaceutic name and state the properties of each of two *chlorides of mercury. (September, 1900.)*

257 to 263. Simon's Manual of Chemistry, pages 246 and 247.

264. (a) *Distinguish between* ic *and* ous *terminations.* (b) *Give the formula and properties of* (1) *mercurous chloride,* (2) *mercuric chloride. (September, 1901.)*

265. (b) *Give the chemical name and properties of* (1) *calomel,* (2) *corrosive sublimate.* (c) *Mention two easily applied tests that will distinguish one from the other. (January, 1898.)*

264 and 265. (a) The termination *ous* is used with the compound containing the less proportion of the more electro-negative element; and the termination *ic* with the compound containing the greater proportion of the more electro-negative element. See, also, Simon's Manual of Chemistry, page 104. (b) pages 246 and 247; (c) page 250.

266. Give the formula, synonyms, and properties of (a) *mercurous iodide,* (b) *mercuric iodide. (September, 1902.)*

267. (c) *What compound is formed by a mixture of mercuric salts and potassium iodide? (June, 1892.)*

266 and 267. (a) Simon's Manual of Chemistry, page 247; (b) page 247; (c) Mercuric chloride and potassium iodide give potassium chloride and mercuric iodide:

$$HgCl_2 + 2KI = 2KCl + HgI_2$$

268. (a) *What salt of mercury is soluble in water?* (b) *Give the name and formula of a salt of silver used in medicine. (April, 1899.)*

269. (c) *Mention* two *salts of mercury commonly used in medicine. Give their formulas.* (*May, 1899.*)

268 and 269. (a) Mercuric chloride is soluble in sixteen parts of cold water and two parts of boiling water. (b) Silver nitrate, $AgNO_3$; (c) Simon's Manual of Chemistry, pages 246 and 247.

270. By what tests can a determination be reached as to whether a given powder is bismuth subnitrate or calomel? (*May, 1902.*)

270. 1. Place a little of the powder in a test-tube; add some lime-water, and agitate. It becomes *black* if the powder was *calomel*, and remains *white* if the powder was bismuth subnitrate. 2. Heat on porcelain or iron; calomel is completely volatilized; bismuth subnitrate is unchanged.

271. What is the test for the presence (a) *of silver*, (b) *of mercury*, (c) *of lead?* (*May, 1895.*)

272. (b) *How may the presence of mercury be detected in a solution?* (*September, 1902.*)

271 and 272. (a) Simon's Manual of Chemistry, page 243; (b) page 250; (c) page 234.

273. Mention the antidotes applicable in cases of poisoning from (a) *mineral acids*, (b) *corrosive sublimate.* (*January, 1894.*)

274. (b) *What treatment is indicated in a case of poisoning by mercuric chloride?* (*June, 1900.*)

275. (c) *On what theory are eggs given in cases of poisoning by corrosive mercury?* (*June, 1896.*)

273 to 275. (a) Magnesia and water, or a solution of soap; (b) Simon's Manual of Chemistry, page 250; (c) The mercury forms with the white of egg an albuminate which is *insoluble.*

B. ORGANIC CHEMISTRY.

1. Acyclic Hydrocarbons. First Series: Paraffins.

276. (a) What is organic chemistry? (*November, 1892.*)

277. (a) What is organic chemistry? (b) *State the general properties of organic compounds.* (September, 1899.)

278. (a) *What is* organic chemistry, *and* (c) *what elements enter into the composition of all organic bodies?* (*January, 1897.*)

279. (a) *What is organic chemistry?* (c) *Mention the elements that enter into the composition of most organic compounds.* (*May, 1902.*)

280. (c) *Name and* (d) *briefly describe four elements which most frequently enter into the formation of organic bodies.* (*November, 1893.*)

281. (c) *What* four *elements comprehend the usual composition of organic compounds?* (d) *Give the preparation and general chemistry of any* one *of these four elements.* (*September, 1901.*)

282. (e) *What is the relative importance of the element carbon in organic chemistry?* (*June, 1893.*)

276 to 282. (a) Simon's Manual of Chemistry, pages 331 and 332; (b) page 332; (c) page 332; (d) pages 135, 116, 111 and 124; (e) It is of paramount importance, for *every* organic compound must contain carbon; and although Simon defines organic chemistry as "the chemistry of carbon compounds containing *carbon in a combustible form,*" some writers (*e. g.*, Witthaus' Manual of Chemistry) include under organic chemistry every compound containing carbon in any form.

283. (a) *What is understood by isomerism?* (*January, 1893.*)

284. When are substances said to be (a) *isomeric,* (b) *metameric,* (c) *polymeric?* (*January, 1901.*)

283 and 284. (a) Simon's Manual of Chemistry, page 343; (b) page 343; (c) page 344.

285. (a) *What is methane (marsh gas)?* (b) *Under what conditions is it formed in nature?* (*April, 1897.*)

286. (a) *What is* methane? (c) *Give the formula, and state the chemical importance of methane.* (*January, 1901.*)

287. (d) Give the formula and properties of methane, and describe its preparation. (*April,* 1898.)

288. (d) *Give the composition and properties of marsh gas.* (*September, 1893.*)

285 to 288. (a) Simon's Manual of Chemistry, pages 356 and 140; (b) page 140; (c) pages 356, 355, 340; (d) pages 356 and 140.

289. Give equations showing a mode of preparation of (a) *AgCl*, (b) CO_2, (c) CH_4. (*September, 1896.*)

289.

(a) $AgNO_3 + HCl = HNO_3 + AgCl$

(b) $CaCO_3 + 2HCl = CaCl_2 + H_2O + CO_2$

(c) Simon's Manual of Chemistry, page 357.

290. (a) *What is* petroleum? (b) *What important derivations of petroleum are used in medicine?* (*June, 1898.*)

291. (c) *Mention the products obtained from petroleum, and* (b) *give the names of those used in medicine.* (*May, 1901.*)

292. (a) *What is coal-oil, and* (b) *what are some of its principal products used in the practice of medicine?* (*January, 1897.*)

293. (d) *Mention the source and uses of benzine.* (*June, 1902.*)

294. (e) *What are the source and principal properties of vaseline?* (*September, 1895.*)

290 to 294. (a) Simon's Manual of Chemistry, page 358; (b) Petrolatum liquidum, petrolatum molle, petrolatum spissum; (c) Simon's Manual of Chemistry, page 359; (d) page 359. Used as solvent in making paints and varnishes; also as separatory solvent in proximate organic analysis. (e) Simon's Manual of Chemistry, pages 359 and 360.

295. (a) *What is the formula of chloroform?* (b) *State how chloroform is prepared.* (*January, 1899.*)

296. (b) *What is* chloroform, *and how is it made?* (*January, 1900.*)

297. (b) Give a method of preparing chloroform. (*September, 1901.*)

298. (b) *Describe the manufacture of chloroform.* (*June, 1895.*)

299. (b) *Give the composition and* (c) *the properties of chloroform.* (*June, 1895.*)

295 to 299. (a) Simon's Manual of Chemistry, page 376; (b) pages 376 and 377; (c) page 377.

300. (a) *Give the chemical name of iodoform.* (b) *How is iodoform made?* (*January, 1898.*)

301. (c) *What is iodoform?* (d) *What is its chemical formula, and* (b) *from what substances is it formed?* (*April, 1898.*)

302. (b) *How is iodoform made?* (e) *What are the properties of iodoform?* (*January, 1899.*)

303. (b) *How is iodoform made? Mention* (e) *its properties and* (f) *its uses in medicine.* (*September, 1899.*)

304. (e) *State the principal properties and* (f) *the uses of iodoform.* (b) *How is iodoform made?* (*January, 1902.*)

300 to 304. (a) Tri-iodomethane; (b) Simon's Manual of Chemistry, page 379:

$$2KHCO_3 + 4I_2 + C_2H_5OH = 2KI + 3H_2O + 2CO_2 + 2CHI_3$$

(c) Simon's Manual of Chemisty, page 379; (d) page 379; (e) page 379; (f) Iodoform is used chiefly as a surgical dressing; it is antiseptic, but not germicidal. Externally it is used in syphilitic sores, fissure of the anus, and irritated hemorrhoids. Internally, it is used in tertiary syphilis; injections of iodoform are also used in tubercular disease of the joints and pleuræ. (From Hare's *Practical Therapeutics.*)

305. (a) *What is an alcohol?* (*November, 1892.*)

306. (b) *What is methylic alcohol? What are its properties and uses?* (*September, 1896.*)

305 and 306. (a) Simon's Manual of Chemistry, page 364, lines 2 and 3; (b) page 367.

307. (a) What is ethyl hydrate? Give (b) *its ordinary name and (c) its chemical formula.* (April, 1893.)

308. (a) *What is* ethyl hydrate? *Give* (c) *its formula and* (d) *state how it is produced?* (*January, 1900.*)

309. (e) *What is the chemical designation of the ordinary alcohol of commerce?* (*November, 1891.*)

310. (d) *What is the substance* (*or substances*) *from which ordinary alcohol is derived?* (*September, 1892.*)

311. (f) *What are the differences between common alcohol and absolute alcohol?* (*May, 1896.*)

307 to 311. (a) Same as ethyl hydroxide. Simon's Manual of Chemistry, page 367; (b) page 367; (c) page 367; (d) page 367; (e) page 367; (f) page 369.

312. What is fermentation? (*March, 1893.*)

312. Simon's Manual of Chemistry, pages 347 and 491. "Fermentation is a decomposition of an organic substance, produced by the processes of nutrition of a low form of animal or vegetable life." (Witthaus' *Manual of Chemistry.*)

313. What is acetous *fermentation?* (*May, 1895.*)

313. Simon's Manual of Chemistry, page 386.

314. What is alcoholic fermentation? Illustrate. (*September, 1896.*)

315. Describe and illustrate alcoholic fermentation. (*January, 1900.*)

316. What changes take place in alcoholic fermentation? (*July, 1893.*)

314 to 316. Simon's Manual of Chemistry, pages 367 and 368.

317. What is the chemical change which occurs in the making of malt? (*April, 1893.*)

317. The insoluble starch contained in the grain is converted into soluble dextrin and maltose by diastase contained in the developing germ. For reaction, see Simon's Manual of Chemistry, page 412.

318. Explain the principle of the action of yeast. (*June, 1895.*)

318. Simon's Manual of Chemistry, pages 367 to 369.

319. (a) *Give a description of the preparation and mention the properties of the principal alcoholic beverages obtained from the fermentation of malted grains.* (*January, 1896.*)

320. (b) *Describe the chemical process for the preparation of alcohol.* (c) *What percentage of alcohol is found in* (1) *beer,* (2) *wine,* (3) *whiskey,* (4) *brandy?* (*May, 1898.*)

321. (d) *How does wine differ chemically from brandy?* (*September, 1892.*)

322. (d) *Wherein do wine, beer, and whiskey differ?* (*May, 1894.*)

323. (d) *Differentiate wine, beer, and whiskey.* (*June, 1901.*)

324. (d) *Name* three *common kinds of spirituous liquors, and describe their manufacture.* (*April, 1895.*)

319 to 324. (a) Simon's Manual of Chemistry, page 370; (b) pages 367 and 368; (c) page 370; (d) page 370.

325. (a) *From what substances is ether obtained?* (*November, 1891.*)

326. (b) *What is ethyl oxide? Give its ordinary name and chemical formula.* (a) *State from what it is derived. Give its mode of production and its chemical equation.* (*May, 1893.*)

327. Describe ethyl oxide, giving (a) *derivation,* (b) *ordinary name, chemical formula, and* (a) *mode of production.* (*April, 1896.*)

328. (c) *Describe the chemistry of alcohols and of ethers.* (*June, 1900.*)

325 to 328. (a) Simon's Manual of Chemistry, pages 401 and 402; (b) page 401; (c) page 363, etc.; 399, etc.

329. (a) *What is an anæsthetic?* (b) *Give the formula and properties of any* one *anæsthetic with which you are familiar.* (*April, 1895.*)

330. (c) *Give the names and formulas of the various gaseous compounds capable of producing general anæsthesia.* (*September, 1900.*)

329 and 330. (a) An anæsthetic is any agent that will produce loss of sensibility; if the loss of sensation is over the whole body, it is called *general* anæsthesia; if only over a part, *local*. (b) For ether, see Simon's Manual of Chemistry, pages 401 and 402; for chloroform, see pages 376 and 377. (c) The three chief are: ether $(C_2H_5)_2O$; chloroform, $CHCl_3$; nitrous oxide, N_2O; others that are, or have been, employed: ethene chloride, $C_2H_4Cl_2$; ethyl bromide, C_2H_5Br.

331. Give the formula of (a) *alcohol,* (b) *ether,* (c) *acetic acid. (June, 1898.)*

331. (a) C_2H_5OH; (b) $(C_2H_5)_2O$; (c) $CH_3.COOH$.

332. (a) *How may acetic acid be obtained? Give* (b) *formula and* (c) *uses. (September, 1896.)*

333. State (a) *the preparation,* (d) *appearance,* (b) *formula, and* (c) *uses of acetic acid. (April, 1898.)*

334. (e) *What is acetic acid?* (a) *What is the source of acetic acid?* (f) *In what forms does acetic acid appear? (April, 1899.)*

335. (a) *From what source is acetic acid derived?* (f) *Mention its most common and its purest form. (April, 1893.)*

336. (g) *Give the chemistry of acetic acid and* (h) *mention the most important acetates. (January, 1899.)*

332 to 336. (a) Simon's Manual of Chemistry, page 386; (b) $CH_3.COOH$; (c) Used as a test for albumin, as a solvent for camphor and various resins; and to manufacture the acetates. It is also used as a hæmostatic, and to allay thirst; sometimes it is used as vinegar. (d) Simon's Manual of Chemistry, page 387; (e) page 386; (f) page 387; (g) pages 386 and 387, and Q. 332 to 335; (h) pages 388 and 389.

337. Explain the process of distillation. (May, 1894.)

337. Simon's Manual of Chemistry, page 36. "The substance is heated in a vessel called a *still*. It should not boil, but only simmer gently. As vapor arises in the still it is received in the *worm*. In this the vapor is condensed and

escapes below in a fluid state. As a rule, the first fifth and last two-fifths are not collected. The first contains vapors which are objectionable; the last two, salts in increasing quantity. *The still:* Its essential features are a vessel containing the liquid, a head which fits tightly on it, and from which a tube leads to the *worm*, which consists of a long, spiral tube placed in a vessel kept constantly full of cold water." (Martin and Rockwell's *Chemistry and Physics.*)

338. (a) *What is destructive distillation?* (b) *What gases are usually generated during the process of destructive distillation?* (*June, 1897.*)

339. (a) *What is meant by the destructive distillation of wood, and* (c) *what are some of the principal products of such a process?* (*May, 1895.*)

338 and 339. (a) Simon's Manual of Chemistry, page 345; (b) page 360; (c) page 360.

340. What is vinegar? (*June, 1892.*)

340. Simon's Manual of Chemistry, page 387.

341. What are compound ethers? *Give an example.* (*April, 1898.*)

341. Compound ethers are substances formed by replacing the hydrogen of an acid by a hydrocarbon radical. They resemble salts, the hydrocarbon radical being inserted instead of a metal. They are better called Esters.

Example: $\left.\begin{matrix}NO_2\\H\end{matrix}\right\}O$ = nitric acid.

$\left.\begin{matrix}NO_2\\C_2H_5\end{matrix}\right\}O$ = ethyl nitrate, or nitric ether, a compound ether or ester.

342. (a) *Describe chloral hydrate.* (*May, 1894.*)

343. (b) *What reaction takes place when chloral hydrate is mixed with an alkali? Illustrate.* (*April, 1899.*)

344. (c) *How does chloral differ from chloroform?* (*June, 1892.*)

345. (c) *Give the chemical differences between chloral and chloroform.* (*September, 1895.*)

342 to 345. (a) Simon's Manual of Chemistry, page 375; (b) page 375; (c) pages 375 and 376. The graphic formulæ may be represented thus:

Chloral. Chloroform.

346. Define (a) *acetone,* (b) *ketone,* (c) *aldehyde.* (*May, 1892.*)

346. (a) Simon's Manual of Chemistry, page 380; (b) pages 379 and 380; (c) page 372. Note small print at bottom of page 379 and top of page 380.

347. What are amins? Give an example. (*June, 1898.*)

347. Simon's Manual of Chemistry, pages 417 and 418.

348. (a) *Describe cyanogen and its principal compounds.* (*September, 1895.*)

349. Give (b) *the preparation,* (c) *formula,* (d) *properties, and* (e) *uses of potassium cyanide.* (*June, 1898.*)

350. (f) *What is the antidote for poisoning from hydrocyanic acid?* (*November, 1894.*)

351. Mention the antidotes applicable in cases of poisoning from (g) *zinc chloride,* (f) *hydrocyanic acid.* (*November, 1893.*)

348 to 351. (a) Simon's Manual of Chemistry, pages 420 to 423; (b) page 422; (c) page 422; (d) page 422; (e) Used in the laboratory as a reducing agent, also used in photography as a solvent for the unchanged silver in the film; also as a solvent for silver sulphide or oxide on silverware. Its chief medical uses are: in bronchitis or phthisis with excessive cough; gastralgia of nervous origin; enteralgia; and externally in pruritus. (From Hare's *Practical Therapeutics.*) (f) Simon's Manual of Chemistry, page 424; (g) page 229.

Second Series : Olefins.

352. What is olefiant gas? Name some of its properties. (*May, 1895.*)

352. Olefiant gas, *or* ethene, *or* ethylene, $CH_2=CH_2$, is a colorless, tasteless gas, with slight odor; is sparingly soluble in water; is irrespirable, burns with a white flame, and is explosive when mixed with air or oxygen. See Simon's Manual of Chemistry, pages 140 and 362.

353. Describe the prominent properties of CO. (May, 1902.)

353. Simon's Manual of Chemistry, page 139.

354. (a) *Give the formula and properties of each of* two *oxides of carbon,* (b) *explaining the effect of each on animal life. (September, 1900.)*

355. (c) *Name two methods of producing carbon dioxide. (March, 1892.)*

356. (d) *Give the physical and the chemical properties of carbon dioxide.* (e) *In what proportion does carbon dioxide exist in air? (May, 1902.)*

357. (c) *How is CO_2 produced?* (f) *Give the chemistry of CO_2. (September, 1901.)*

358. (f) *What is* carbon dioxide? *Give its formula, properties, uses, and mode of production. (January, 1900.)*

359. (g) *Mention a test of CO_2, and* (d) *also its chief properties. (April, 1893.)*

354 to 359. (a) Simon's Manual of Chemistry, pages 139, 136 and 137; (b) Carbon monoxide is a very active poison. For carbon dioxide, see Simon's Manual of Chemistry, page 137; (c) page 136; (d) page 137; (e) page 137; (f) pages 136 to 138. *Uses:* "In manufacture of carbonates and bicarbonates, carbonated beverages, white lead; the decomposition of the sucrate of lime in the preparation of sugar from beets, in setting free the hypochlorites from chloride of lime, in bleaching, and in giving a *bead* to beer, ale, and wine, etc." (*Reference Handbook of the Medical Sciences,* vol. ii., page 660.) (g) Simon's Manual of Chemistry, page 139.

360. (a) *Mention the constituents of the atmosphere.* (b) *From what sources does the atmosphere become deteriorated and unfit for respiration? (January, 1900.)*

361. (a) *Give the composition of air.* (c) *What percentage of CO_2 exists normally in the atmosphere?* (d) *What percentage of CO_2 is dangerous to life?* (*January, 1898.*)

362. (a) *What is the composition of the atmosphere?* (d) *What percentage of CO_2 must be present to render the inhalation of air dangerous to life?* (*May, 1900.*)

363. (e) *What is the difference, chemically, between expired and inspired air?* (*March, 1892.*)

364. (e) *What chemical changes take place in the air when inhaled?* (*May, 1893.*)

365. (e) *Give the chemical changes occurring in the air in respiration.* (*September, 1896.*)

366. (e) *Give the chemistry of respiration, showing what is inhaled, what is exhaled, and* (f) *how the gases enter and leave the blood.* (*June, 1900.*)

367. (g) *What chemical changes take place in the blood and in* (e) *the air breathed during respiration?* (*June, 1897.*)

368. (h) *Give the chemical difference between the blood in the pulmonary artery and the blood in the pulmonary vein.* (*September, 1902.*)

369. (i) *How can the presence of appreciable quantities of CO_2 in a room be determined?* (*June, 1895.*)

370. (i) *How is the air in an apartment tested to determine the presence and amount of carbon dioxide in it?* (*May, 1899.*)

360 to 370. (a) Simon's Manual of Chemistry, page 125; (b) page 137, last line; (c) page 137; (d) page 138; (e) For inspired air, see Simon's Manual of Chemistry, page 125. Expired air consists of oxygen 16.6, nitrogen 79, carbon dioxide 4.4. It also contains more watery vapor, is of the body temperature; may contain traces of H, CH_4 or NH_4; its volume is diminished, and it does not contain the bacteria and dust with which the inspired air may be charged. (f) Simon's Manual of Chemistry, pages 501 and 502; (g) "The blood parts with its excess of carbon dioxide and watery vapor to the alveolar air; the blood at the same time receives from the alveolar air a supply of oxygen

which renders it arterial." (Kirke's *Physiology.*) (h) "The following changes in the blood are noted after passing through the pulmonary capillaries: (1) Color, deep purple to bright scarlet by oxidation of the reduced hæmoglobin—*i. e.*, from venous becoming arterial blood; (2) gains oxygen; (3) loses carbonic acid; (4) becomes cooler; (5) coagulates more readily." (Collins and Rockwell's *Physiology.*) (i) "Make a mark on any test-tube—say, one inch from the bottom. Fix the bulb of an atomizer to a small, glass capillary tube, sufficiently long to reach to the bottom of the test-tube, and in such a manner that a definite quantity of air is forced from the bulb through the tube at each compression. *To use:* Fill the test-tube exactly to the mark with a saturated solution of lime-water; take the apparatus into the out-door air and find out how many compressions of the bulb are needed, driving the air slowly through the lime-water each time, to make the lime-water just turbid enough to obscure a pencil-mark on white paper placed beneath the test-tube and viewed from above. Then rinse out the test-tube, fill exactly to the mark again with lime-water, and repeat the process in the room the air of which is to be examined. We then assume that the out-door air contains the normal amount of CO_2, 0.04 per cent. (unless we happen to know the actual amount in the atmosphere at the time), and estimate the percentage of CO_2 in the air of the room by the following proportion: Let x = the percentage of CO_2 in the air of the room. *Then the number of compressions of the bulb required in the outer air : the number of compressions required in the room : : x : 0.04.* If the actual percentage of CO_2 in the outer air is known, substitute this for the 0.04 per cent. in the formula. Care must be taken in using this device not to draw any of the lime-water up into the bulb." (Egbert's *Hygiene and Sanitation,* page 402.)

371. Mention the antidotes applicable in cases of poisoning from (a) *oxalic acid,* (b) *copper sulphate.* (*April, 1894.*)

371. (a) Simon's Manual of Chemistry, page 392; (b) page 237.

372. (a) *What is glycerin?* (b) *How is it chemically classified?* (*April, 1898.*)

373. (b) *To what class of organic compounds does glycerin belong?* (c) *From what source is glycerin obtained?* (*September, 1898.*)

374. (a) *What is glycerin, and* (c) *how is it obtained?* (*March, 1893.*)

375. (a) *Describe glycerin, and* (c) *state how it is obtained.* (*September, 1896.*)

376. (a) *What is glycerin?* (c) *State its method of preparation and* (a) *give its properties.* (*May, 1899.*)

377. (a) *What is* glycerin? (c) *How is it prepared, and* (d) *what are its uses?* (*June, 1896.*)

372 to 377. (a) Simon's Manual of Chemistry, page 371; (b) as a triatomic alcohol; (c) Simon's Manual of Chemistry, page 371. For equation, see page 405. (d) Glycerin is used for preserving fruit, sweetening liqueurs, wine, beer, and malt extracts, as a lubricant for the works of watches and chronometers, for making copying inks, as a solvent for tar colors, for preserving anatomical specimens, in the manufacture of nitroglycerin. Medicinally it is used: as a sweetening agent in the food of diabetics; in acute coryza; in cases of impacted cerumen; as a mouth wash; and in congestion of the cervix of the uterus, glycerin, locally applied, acts as a depletant. (From Hare's *Practical Therapeutics.*)

378. (a) *What is the chemical designation of nitroglycerin?* (b) *How is nitroglycerin manufactured?* (*June, 1898.*)

379. (b) *How is nitroglycerin prepared, and* (c) *what is its composition?* (*June, 1895.*)

380. (c) *What is nitroglycerin?* (d) *Give the medical properties of nitroglycerin.* (*June, 1901.*)

378 to 380. (a) Trinitroglycerol, *or* glyceryl trinitrate;

(b) Simon's Manual of Chemistry, pages 371 and 372; (c) pages 371 and 372. (d) It is used to produce muscular relaxation; as a nervous depressant and sedative; and to lessen arterial pressure. It is much used in angina pectoris, chorea, and epilepsy; also in asthma. (From Hare's *Practical Therapeutics.*)

381. Give the source and characteristics of citric acid. (September, 1902.)

381. Simon's Manual of Chemistry, page 396.

382. What organic acids are present in vegetables and fruits? (June, 1897.)

382. Malic acid is present in apples and cherries; tartaric acid is present in grapes, cucumbers, and potatoes; citric acid is present in lemons, currants, raspberries and gooseberries; oxalic acid is present in sorrel, spinach, rhubarb, and tomatoes. (From Herter's *Chemical Pathology.*)

383. Explain (a) *the constitution of the fats, and* (b) *the process of saponification. (June, 1900.)*

384. Define (c) emulsion, (d) soap, (b) saponification. *(April, 1896.)*

385. (d) *What is a soap? (January, 1893.)*

383 to 385. (a) Simon's Manual of Chemistry, page 404; (b) Saponification is a double decomposition occurring between a fat and an alkali, resulting in the formation of a soap and glycerin. See Simon's Manual of Chemistry, page 405. (c) An emulsion is a liquid rendered milky by the suspension in it of finely divided particles of fat, oil or resin. (Duane's Medical Dictionary.) (d) Simon's Manual of Chemistry, page 405.

Third Series.

386. (a) *What are the constituents of common illuminating gas?* (b) *How is it prepared?* (c) *Why is it poisonous? (January, 1898.)*

387. (b) *Describe the manufacture of illuminating gas. (June, 1893.)*

388. (b) *Describe a process for manufacturing illuminating gas.* (*May, 1896.*)

389. (b) *How is illuminating gas made from coal?* (*March, 1892.*)

390. (c) *Account for the poisonous property of illuminating gas.* (*May, 1893.*)

386 to 390. (a) Simon's Manual of Chemistry, page 360; (b) page 360; (c) Mainly because of the presence of CO (carbon monoxide).

391. How do candles and gas-lights compare with human beings in regard to the quantity of oxygen which they consume and of carbon dioxide which they produce? (*May, 1902.*)

391. "A candle about equals an adult man in the quantity of O consumed, and of CO_2 produced in its combustion. An ordinary gas-burner is equal to ten adults." (Witthaus' *Essentials of Chemistry.*)

392. Explain the construction of the safety lamp used by miners, and state the principle involved. (*September, 1893.*)

392. The flame is completely surrounded by fine-meshed wire gauze, which, by absorbing, radiating, and conducting away heat rapidly, prevents the gases outside being raised in temperature to the ignition point by the flame. Holding fine wire gauze over a Bunsen flame illustrates the principle; the flame is unable to pass through the gauze.

393. How does fire-damp explode mines? (*July, 1893.*)

393. Simon's Manual of Chemistry, page 140. In the presence of a naked flame, the temperature of part of the gas-mixture is brought to the combining point.

394. (a) *Explain the chemistry of a candle flame.* (*April, 1893.*)

395. (b) *Explain the principle of the Bunsen burner.* (*September, 1892.*)

396. (c) *Explain the use and the principle underlying the use of the blow-pipe.* (*March, 1893.*)

397. (c) *What effect is produced in mixing air with a blast flame as practised with an ordinary blow-pipe.* (*November, 1892.*)

394 to 397. (a) Simon's Manual of Chemistry, page 140; (b) page 141; (c) "The blow-pipe is a tube with a narrow nozzle, by which a continuous current of air can be passed into a common flame. The effect of blowing across a flame is, first, to alter the shape of the flame, which is at once narrowed and lengthened; and, in the second place, to extend the sphere of combustion from the outer to the inner part. As the latter circumstance causes an increase of the heat of the flame and the former a concentration of that heat within narrower limits, it is easy to understand the great heat of the blow-pipe flame. The way of holding the blow-pipe and the strength of the blast always depend upon whether the operator wants a reducing or an oxidizing flame. The *reducing* flame is produced by keeping the jet of the blow-pipe just on the border of a tolerably strong gas-flame and driving a moderate blast across it. The resulting mixture of the air with the gas is only imperfect, and there remains between the inner, bluish part of the flame and the outer, barely visible part a luminous and reducing zone, of which the hottest point lies somewhat beyond the apex of the inner cone. To produce the *oxidizing* flame the gas is lowered, the jet of the blow-pipe pushed a little farther into the flame, and the strength of the current somewhat increased. This serves to effect an intimate mixture of the air and gas, and an inner-pointed, bluish cone, slightly luminous toward the apex, is formed, and surrounded by a thin, pointed, light-bluish, barely visible mantle. Bodies to be oxidized are held a little beyond the apex that there may be no want of air for their combustion." (Muter's *Analytical Chemistry.*)

398. What are the products of the combustion of ordinary coal? (*January, 1894.*)

398. CO_2, H_2O; and, if the supply of air be limited, CO.

399. (a) *What is the source of tartaric acid?* (b) *What double salts of this acid are used in medicine?* (*May, 1900.*)

400. (a) *What is the source of tartaric acid?* (c) *What is its use in medicine?* (*June, 1895.*)

401. (d) *Give the chemical name, properties, and uses of tartar emetic.* (*September, 1898.*)

402. Give the source of (a) *tartaric acid,* (e) *the tartrates.* (*January, 1902.*)

399 to 402. (a) Simon's Manual of Chemistry, page 393; (b) pages 394 and 395; (c) "It is rarely used alone, and is most commonly employed to act upon sodium or potassium bicarbonate to form effervescent drinks." (Hare's *Practical Therapeutics*, page 414.) (d) Simon's Manual of Chemistry, page 395. *Uses:* As a circulatory quieter and sedative; as an expectorant; as an emetic; as a diaphoretic; to relax muscles; and as a counter-irritant. (From Hare's *Practical Therapeutics.*) (e) Simon's Manual of Chemistry, pages 394 and 395.

403. Give the sources from which the following acids are obtained: (a) *acetic,* (b) *citric,* (c) *lactic,* (d) *oxalic,* (e) *tartaric.* (*June, 1896.*)

403. (a) Simon's Manual of Chemistry, page 386; (b) page 396; (c) page 398; (d) page 391; (e) page 393.

Carbohydrates.

404. (a) *What are carbohydrates?* (b) *Into what* three *groups are these compounds usually divided?* (*September, 1898.*)

404. (a) Simon's Manual of Chemistry, page 407; (b) page 408.

405. (a) *What are hydrocarbons?* (b) *Name* three *articles of food belonging to this class.* (*May, 1896.*)

405. (a) Hydrocarbons are compounds consisting only of hydrogen and carbon; (b) Carbohydrates are almost certainly meant here. Note the distinction between carbo-

hydrate and hydrocarbon. See Simon's Manual of Chemistry, pages 407 and 408.

406. (a) *What is a hydrocarbon?* (b) *What is a* sugar? (*April, 1899.*)

407. (b) *Give the chemical meaning of the term sugar.* (*June, 1896.*)

408. (c) *Name three substances usually classed as sugars.* (*January, 1892.*)

409. (c) *Name and differentiate the three classes of sugar.* (*May, 1895.*)

410. (d) *What are the properties and uses of glucose?* (*September, 1894.*)

411. (d) *Describe glucose and state its importance in medical chemistry.* (*January, 1900.*)

412. (e) *Differentiate chemically sucrose, glucose, lactose, and maltose.* (*September, 1900.*)

413. (f) *Differentiate grape-sugar and cane-sugar.* (*June, 1902.*)

414 (b) *Define and describe* sugars. (e), (f). *How do glucoses differ from saccharoses?* (g) *What kind of sugar is found in diabetic urine?* (*January, 1898.*)

415. What is (h) *starch,* (i) *dextrin?* (*June, 1901*).

416. (h) *Mention the properties of starch.* (*January, 1893.*)

417. (j) *Distinguish between starch and sugar.* (k) *By what histological element is starch converted into sugar?* (*April, 1894.*)

406 to 417. (a) See Q. 405; (b) A carbohydrate having a sweet taste; (c) (1) Glucoses, $C_6H_{12}O_6$, as grape-sugar. See Simon's Manual of Chemistry, page 409. (2) Saccharoses, $C_{12}H_{22}O_{11}$, as cane-sugar. See page 411. (3) Amyloses, $C_6H_{10}O_5$, as starch. See page 413. (d) pages 409 and 576; (e) Sucrose = saccharose, page 411; glucose, page 409; lactose, page 412; maltose, page 412; (f) pages 409 and 411; (g) glucose; (h) Simon's Manual of Chemistry, page 413; (i) page 413; (j) pages 413, 409 and 411; (k) By ptyalin,

the ferment contained in the saliva; and also by amylopsin, the amylolytic ferment of the pancreatic juice.

418. (a) *What is glycogen?* (b) *From what is it derived?* (*September, 1897.*)

419. (b) *Where is glycogen found, and* (c) *what are its properties?* (*September, 1901.*)

420. (b) *Where is glycogen found?* (c) *Give the properties of glycogen.* (*September, 1902.*)

418 to 420. (a) Simon's Manual of Chemistry, page 415; (b) page 415; (c) page 415.

421. (a) *What preparation of gun-cotton is used in medicine and* (b) *what is its solvent?* (*November, 1893.*)

422. (c) *How is collodion prepared, and* (d) *what are its uses?* (*June, 1893.*)

421 and 422. (a) Collodion; (b) A mixture consisting of three volumes of ether and one volume of alcohol; (c) By dissolving pyroxylin in (b); (d) As a protective film to cover the skin; as a protective to wounds and cuts.

2. Cyclic Hydrocarbons and their Derivations.

423. Give the sources and explain the uses of benzene. (*April, 1896.*)

423. Simon's Manual of Chemistry, pages 431 and 432.

424. (a) *Give the formula for carbolic acid.* (b) *How is it obtained, and* (c) *what are its properties and* (d) *uses?* (*June, 1896.*)

425. (b) *Give the sources and* (d) *uses of carbolic acid.* (*May, 1898.*)

424 and 425. (a) Simon's Manual of Chemistry, page 438; (b) pages 438 and 439. It is also formed by heating salicylic acid and quicklime. (c) Simon's Manual of Chemistry, pages 438 and 439. (d) Internally in nervous vomiting, fermentative diarrhœa; externally, as a local anæsthetic, in pruritus and eczema. (From Hare's *Practical Therapeutics.*)

426. What is the source of (a) *citric acid? of* (b) *acetic acid? of* (c) *carbolic acid? (January, 1895.)*

426. (a) Simon's Manual of Chemistry, page 396; (b) page 386; (c) Q. 424 and 425 (b).

427. (a) *What is the difference between an alcohol and a phenol? Illustrate. (September, 1898.)*

428. (a) *How do phenols differ from alcohols?* (b) *State the properties and uses of phenol. (September, 1902.)*

427 and 428. (a) "The phenols differ from the alcohols in not furnishing by oxidation corresponding aldehydes and acids; in not dividing into water and hydrocarbon under the influence of dehydrating agents; in not reacting with acids to form ethers; in combining to form directly products of substitution with Cl and Br; and in forming with metallic elements compounds more stable than similar compounds of the true alcohols. In short, the phenols appear to have, besides an alcoholic function, more or less of the function of acids." (Witthaus' *Manual of Chemistry.*) (b) See Q. 424 and 425 (c) and (d).

429. Define (a) *alcohol,* (b) *ether,* (c) *phenol. (January, 1902.)*

429. (a) Simon's Manual of Chemistry, page 364; (b) page 399; (c) page 438.

430. What products of phenol are of interest in medicine? (March, 1893.)

430. Carbolic acid, creosote, phenacetine, resorcin, pyrogallic acid, sodium sulphocarbolate, zinc sulphocarbolate, guaiacol.

431. Mention the antidotes applicable in cases of poisoning from (a) *caustic alkalies,* (b) *carbolic acid. (June, 1893.)*

432. (b) *What antidotes should be applied in a case of carbolic acid poisoning? (September, 1895.)*

433. (b) *What is the chemical antidote for poisoning by carbolic acid?* (c) *Give the formula of carbolic acid. (June, 1898.)*

434. (b) *What is the chemical treatment for carbolic acid poisoning?* (*September, 1898.*)

435. What antidotes should be used in case of poisoning by (d) *arsenic,* (b) *carbolic acid?* (*May, 1901.*)

431 to 435. (a) Simon's Manual of Chemistry, page 182; (b) page 439, and alcohol; (c) page 438; (d) See Q. 175 to 179.

436. (a) *From what oil may salicylic acid be obtained?* (b) *Give its properties.* (*September, 1896.*)

437. (c) *How was salicylic acid originally derived?* (d) *How is it now manufactured?* (b) *What are its properties?* (*September, 1894.*)

436 and 437. (a) Simon's Manual of Chemistry, page 443; (b) page 443; (c) "It was first obtained from essence of *spiræa,* which consists largely of salicylic aldehyde, and subsequently from oil of wintergreen (gaultheria), which contains methyl-salicylate, and also from *salicin,* a glucoside; it is now obtained from phenol." (Witthaus' *Manual of Chemistry.*) (d) Simon's Manual of Chemistry, page 443.

438. Give the reaction of tannin with (a) *preparations of iron,* (b) *gelatin.* (*September, 1902.*)

438. (a) Simon's Manual of Chemistry, pages 445 and 220; (b) page 445.

439. What is the source of phenacetin? (*September, 1894.*)

439. Simon's Manual of Chemistry, page 451.

440. (a) *Name the coal-tar products useful in medicine, and* (b) *give the general method of manufacture of any one of them.* (*September, 1896.*)

440. (a) Acetanilid, antipyrin, carbolic acid, creosote, benzoic acid, picric acid, salicylic acid, guaiacol, hypnal, naphthalin, β-naphthol, phenacetin, resorcin, salol; (b) for carbolic acid, see Simon's Manual of Chemistry, page 438.

441. (a) *What is synthesis?* (b) *Mention* three *coal-tar*

products extensively used in medicine that are prepared in the chemical laboratory by synthesis. (*April, 1899.*)

441. (a) Simon's Manual of Chemistry, page 92; (b) Acetanilid, antipyrin, picric acid.

442. Give the names of some of the synthetic preparations, originally designated as coal-tar products, utilized in medical practice to-day. (*June, 1901.*)

442. See Q. 440.

3. Miscellaneous. Alkaloids, Glucosides, Albuminoids, etc.

443. (a) *What is an alkaloid?* (*March, 1893.*)

444. (a) *Define* alkaloid *and* (b) *give an example.* (*September, 1898.*)

445. (a) *What is an alkaloid?* (b) *Name* three *alkaloids used in medicine.* (*April, 1896.*)

446. (b) *Mention* five *well-known alkaloids.* (*July, 1893.*)

447. (a) *What is an alkaloid?* (b) *Name five alkaloids commonly used in medicine?* (*September, 1896.*)

448. (b) *Mention* five *alkaloids and give the derivation of each.* (*January, 1899.*)

449. (a) *Define* alkaloid. (b) *Mention* five *principal alkaloids used in medicine, and give the derivation of each.* (*May, 1900.*)

450. (b) *Mention* five *principal alkaloids used in medicine and name the plants from which they are derived.* (*January, 1895.*)

451. (c) *Give the general properties of alkaloids.* (*January, 1897.*)

452. (d) *What elements enter into the composition of all alkaloids?* (*April, 1893.*)

443 to 452. (a) Simon's Manual of Chemistry, page 455; (b) page 459; (c) page 456; (d) pages 455 and 459.

453. Give two tests for morphine. (*January, 1901.*)

453. Simon's Manual of Chemistry, page 462.

454. (a) *Describe a test for detecting the presence of strychnine.* (*April, 1899.*)

464. (a) *What are* ptomaines? (c) *What are leucomaines?* (d) *How are ptomaines produced?* (*May, 1898.*)

465. Define (a) *ptomaines,* (c) *leucomaines,* (e) *toxins.* (*May, 1901.*)

466. (f) *State the principle underlying the use of antitoxins for the prevention or cure of disease.* (*June, 1899.*)

462 to 466. (a) Simon's Manual of Chemistry, page 473; (b) page 474; (c) page 477; (d) page 474; (e) page 475; (f) page 477.

467. (a) *Give a general definition and description of albuminoids.* (*January, 1895.*)

468. (a) *What are albuminoids?* (b) *Mention some of the important albuminoids.* (*September, 1897.*)

469. (c) *What are the chief substances known as protein bodies, or albuminoids?* (*June, 1893.*)

470. State distinguishing characteristics (d) *of protein bodies and* (e) *of peptones.* (*January, 1901.*)

471. (e) *What are peptones and how are they produced?* (*May, 1898.*)

472. (e) *What are peptones?* (f) *What is turpentine?* (*January, 1895.*)

473. (g) *Define proteid.* (h) *Give some of the physical characteristics of proteids.* (*June, 1901.*)

474. (h) *State the general properties and* (i) *mention the component elements of proteids.* (*June, 1899.*)

475. (j) *What is pepsin?* (*September, 1893.*)

467 to 475. (a) Simon's Manual of Chemistry, pages 486 and 478; (b) pages 486 and 487; (c) Simon does not consider proteins and albuminoids as identical, but regards the latter as a subdivision of the former. See pages 478, 479 and 486. (d) Simon's Manual of Chemistry, page 478; (e) page 482; (f) page 436; (g) pages 479 and 484; (h) pages 479, 480, 482 and 484; (i) pages 479 and 480, (first two lines); (j) page 492.

476. Mention a substance containing albumin (a) *as a liquid, (b) as a solid.* (*January, 1893.*)

476. (a) Milk; (b) Cooked meat.

477. Define and differentiate the following: (a) *Combustion,* (b) *decay,* (c) *fermentation, and* (d) *putrefaction. (May, 1897.)*

478. Give illustrations differentiating (a) *combustion,* (c) *fermentation,* (d) *putrefaction, and* (b) *decay. (September, 1899.)*

479. Define (c) fermentation, (d) putrefaction, (b) decay. *(May, 1896.)*

480. What is the difference between (c) *fermentation and* (d) *putrefaction? (June, 1894.)*

481. Define (c) fermentation, (e) decomposition. *(January, 1897.)*

482. Define and give examples of (c) fermentation, (e) decomposition, (f) destructive distillation. *(September, 1896.)*

483. (c) *What is* fermentation, *and how is it produced?* (g) *What are* enzymes? *(September, 1900.)*

484. (h) *What conditions favor putrefaction?* (i) *What conditions may prevent putrefaction in dead organisms? (May, 1899.)*

477 to 484. (a) Simon's Manual of Chemistry, pages 346 and 114; (b) page 346; (c) pages 347 and 348; (d) pages 347 and 348; (e) Decomposition is the dissociation of the atoms in a molecule, with the formation of two or more simpler molecules or groups of atoms; (f) Simon's Manual of Chemistry, pages 345 and 360; (g) page 491; (h) pages 347 and 348; (i) pages 347 and 348.

485. Define and illustrate (a) *antiseptic,* (b) *disinfectant,* (c) *deodorant,* (d) *cohesion,* (e) *adhesion. (January, 1902.)*

485. (a) Simon's Manual of Chemistry, page 348; (b) page 348; (c) page 349; (d) page 18; (e) page 28.

II. PHYSIOLOGICAL AND CLINICAL CHEMISTRY.

1. Urine.

486. (a) *What is the composition of normal urine?* (*September, 1896.*)

487. (a) *What are the principal constituents of normal urine?* (*June, 1892.*)

488. Give (b) *the average amount and* (a) *the composition of normal urine voided by an adult in twenty-four hours.* (*January, 1899.*)

486 to 488. (a) Simon's Manual of Chemistry, page 549; (b) page 549.

489. How much of each of the following ingredients will be found in the urine of an adult who passes fifty ounces of normal urine daily: (a) *urea,* (b) *chlorides,* (c) *phosphates?* (*November, 1894.*)

489. (a) About 520 grains approximately; (b) about 145 grains approximately; (c) about 35 grains approximately; and see Simon's Manual of Chemistry, page 549.

490. State the normal amount of (a) *total solids,* (b) *urea, and* (c) *uric acid in human urine.* (*January, 1902.*)

490. (a) Simon's Manual of Chemistry, page 549; (b) See Q. 489 (a); (c) about 10 grains; and see Simon's Manual of Chemistry, page 549.

491. A person passes 45 ounces of normal urine daily; give the quantity of each of the following ingredients voided: (a) *urea,* (b) *sulphates,* (c) *phosphates.* (*September, 1895.*)

491. (a) About 450 grains; (b) about 22 grains; (c) about 35 grains; and see Simon's Manual of Chemistry, page 549.

492. Name bodily conditions effecting an increase in the elimination of urine and also those producing a decrease. (*April, 1895.*)

492. *Age,* children pass less, but relatively more than adults; *Sex,* females pass somewhat less than males; *Heat causes less urine to* be passed; *Repose* causes less urine to be

passed; *Exercise*, more urine to be passed; *Food*, greater ingestion of solids causes less urine, and greater ingestion of liquids causes more urine; *Diseases*, nephritis, fevers, and cardiac troubles diminish the quantity; diabetes, epilepsy, nervousness, and chronic interstitial nephritis cause the quantity to be increased.

493. (a) *Describe a urinometer,* (b) *explaining its uses and value as an aid to diagnosis.* (*January, 1895.*)

494. (a) *Describe the urinometer. Give its uses.* (b) *State its importance as an aid to diagnosis.* (*May, 1897.*)

495. (a) *Describe the urinometer. What per cent. of the normal solids of human urine consists of* (c) *the chlorides,* (d) *uric acid?* (*May, 1902.*)

493 to 495. (a) Simon's Manual of Chemistry, pages 561 and 26; (b) "The density is increased when the urine is scanty in amount, whether as the result of fever, acute nephritis, large consumption of solid food, exercise, or free sweating. In all such cases the specific gravity rarely rises above 1035, and usually not above 1028 or 1030. When the specific gravity rises above 1035, and the urine is pale in color, the presence of sugar is to be suspected; and when it rises above 1040 sugar is almost certainly present. (In diabetes mellitus it can rise to 1060 or even higher.) A low specific gravity is encountered in diabetes insipidus, in which it may fall nearly or quite to 1000; generally in the middle or quiescent period of chronic Bright's disease; in the crisis of fevers; in obstructive suppression; in hysterical attacks, and in hydronephrosis." Usually a low specific gravity denotes albumin, and a high specific gravity denotes sugar. (Musser's *Medical Diagnosis.*) (c) 25 per cent.; (d) 0.75 per cent. to 0.8 per cent.

496. The quantity of urine being insufficient for the urinometer, how would you proceed to obtain the correct specific gravity? (*April, 1894.*)

496. *Roughly*, the specific gravity may be obtained by *diluting* the urine with one to four volumes of distilled

water, ascertaining the specific gravity of the dilution by means of the urinometer, and multiply the two end figures by the amount of the dilution. Thus, if *two* volumes of distilled water are added, multiply by *three*. For a more *exact* method, see Simon's Clinical Diagnosis, page 309.

497. (a) *What is the specific gravity of normal urine?* (*March, 1892.*)

498. (a) *What is the specific gravity of normal urine?* (*January, 1893.*)

499. (b) *Define specific gravity.* (c) *What relation does the amount of solid matter in urine bear to the specific gravity of urine?* (*September, 1902.*)

500. State (a) *the normal specific gravity of urine,* (d) *the causes of abnormal deviations in the specific gravity of urine.* (*April, 1898.*)

501. (a) *What is the normal specific gravity of urine? What would be indicated by* (d) *abnormally high specific gravity of urine,* (d) *abnormally low specific gravity of urine?* (*May, 1900.*)

497 to 501. (a) Simon's Manual of Chemistry, page 560; (b) page 25; (c) page 561; (d) See Q. 493 to 495 (b).

502. (a) *What is the presumption as to abnormal constituents in urine having a specific gravity of 1038?* (b) *What test should be applied, and how, to verify the surmise?* (*April, 1896.*)

502. (a) The presence of sugar; (b) Simon's Manual of Chemistry, pages 577 to 580.

503. (a) *What is the presumption as to abnormal constituents in urine having a specific gravity of 1005 or less?* (b) *What tests should be applied, and how, to verify the surmise?* (*May, 1896.*)

503. (a) Albumin and casts; (b) Simon's Manual of Chemistry, pages 570 to 573. Casts are recognized on microscopic examination by careful focusing and shutting off of light. Simon's Manual of Chemistry, pages 590 and 591.

504. (a) *What is the principal source of urea in the human economy?* (*May, 1901.*)

505. (b) *How does diet affect the elimination of urea?* (*January, 1895.*)

506. (c) *How much urea is voided by a healthy adult in twenty-four hours?* (d) *How may the presence and amount of urea be determined?* (*September, 1900.*)

507. (e) *In what form is ammonia found in the urine?* (*September, 1901.*)

504 to 507. (a) Simon's Manual of Chemistry, pages 550 and 539; (b) Animal food causes elimination of the greatest amount of urea, a mixed diet less, a vegetable diet still less, and a non-nitrogenous diet the least of all. The ingestion of water causes an increase in the urea eliminated. Tea, coffee, and alcohol all cause a decrease in the urea eliminated; so also does starvation. (c) See Q. 489 (a); (d) Simon's Manual of Chemistry, pages 551 and 552; (e) As urea, and sometimes as ammonium carbonate.

508. (a) *What is the amount of uric acid excreted in twenty-four hours by an adult, and* (b) *what effect has diet on the quantity so excreted?* (*January, 1896.*)

509. (c) *How may uric acid be obtained from urine?* (*November, 1893.*)

510. (d) *How is excess of uric acid shown in the urine?* (*November, 1892.*)

511. (e) *Give the normal constituents of urine. Give* (f) *the macroscopic and* (g) *the microscopic appearance of urine containing an excess of uric acid.* (*September, 1897.*)

512. (f) *What is the appearance to the naked eye, and* (g) *under the microscope, of urine containing an excess of uric acid?* (*June, 1894.*)

513. (d) *How is an excess of urates determined in a sample of urine?* (*June, 1895.*)

508 to 513. (a) See Q. 490; (b) Practically the same effect as on urea. See Q. 505. (c) Simon's Manual of Chemistry, page 555; (d) See (f) and (g); (e) Simon's

Manual of Chemistry, page 549; (f) The urine on standing has a red deposit like cayenne pepper; it may sometimes be more brown than red; (g) Simon's Manual of Chemistry, pages 587, 588 and 589.

514. What are the distinguishing characteristics of urates and of uric acid as deposited in the urine? (September, 1899.)

514. Simon's Manual of Chemistry, pages 588 and 589.

515. How could you determine chemically whether a urinary deposit were composed of urates or phosphates? (January, 1894.)

515. (1) Add dilute nitric acid; phosphates dissolve, urates persist. (2) Heat; urates dissolve, phosphates persist.

516. Name some of the abnormal chemical constituents of urine. (March, 1892.)

516. Simon's Manual of Chemistry, page 569.

517. Describe your mode of procedure in making a chemical examination of suspected urine. (May, 1894.)

517. Simon's Manual of Chemistry, page 558 *et seq.*

518. (a) *State the normal reaction of urine.* (b) *How is the reaction noted?* (c) *To what is it due? (May, 1898.)*

518. (a) Simon's Manual of Chemistry, page 559; (b) page 560; (c) page 560.

519. (a) *How are chlorides chemically recognized in urinalysis? (May, 1895.)*

520. How is the amount of (b) *the phosphates and of* (a) *the chlorides of the urine estimated? (April, 1899.)*

519 and 520. (a) Simon's Manual of Chemistry, page 562; (b) page 563.

521. (a) *What is albumin? (January, 1892.)*

522. (b) *Upon what property of albumin does its detection in any fluid depend? (March, 1892.)*

523. (c) *How do globulins differ from albumins?* (*May, 1898.*)

524. (d) *What kind of albumin is found in morbus Brightii?* (b) *What properties render it readily detectable?* (*September, 1898.*)

525. (e) *In testing urine by heat in a case of suspected albuminuria, what substances might be precipitated and so make the test deceptive?* (*June, 1893.*)

526. What is the simplest test of the presence of (f) *an acid,* (g) *iodine,* (h) *albumin in urine?* (*November, 1893.*)

527. (i) *Describe the mode of testing for albumin in urine.* (*November, 1891.*)

528. (i) *Give in detail a qualitative test for albumin in urine, noting possible errors.* (*June, 1900.*)

529. (i) *What are the most common tests for albumin?* (*June, 1892.*)

530. Give in detail (j) *a quantitative and* (i) *a qualitative test for recognizing albumin in urine.* (*September, 1896.*)

531. (i) *Give in detail* two *tests for ascertaining the presence of albumin in the urine.* (*April, 1898.*)

532. (i) *Describe two tests for ascertaining the presence of albumin in urine, mentioning precautions to be used.* (*September, 1901.*)

533. (i) *Describe three tests for albumin in urine, and explain fully the necessary precautions in making these tests.* (*April, 1897.*)

534. (k) *What are the chemical constituents of normal urine?* (i) *Give a test for the recognition of albumin in urine.* (*June, 1899.*)

521 to 534. (a) Simon's Manual of Chemistry, page 482; (b) Coagulation under the influence of heat. See pages 482 and 570. (c) page 482; (d) Serum albumin; (e) Simon's Manual of Chemistry, page 570; (f) Blue litmus paper will be turned red by an acid. See pages 275 and 290. (g) Simon's Manual of Chemistsry, page 171; (h) page 570; (i) pages 569 and 570, etc.; (j) pages 573 and 574; (k) page 549.

535. By what chemical tests may the presence of blood in urine be detected? (*June, 1902.*)

535. Simon's Manual of Chemistry, page 575.

536. (a) *What form of sugar is that found in urine in diabetes?* (*March, 1892.*)

537. (a) *What kind of sugar is found in diabetic urine?* (*June, 1893.*)

538. What conditions of the urine would lead to the suspicion of (b) *sugar,* (c) *albumin?* (d) *Give a test for each.* (*June, 1902.*)

539. (e) *Give the appearance, specific gravity, and the odor usual to diabetic urine.* (f) *Describe Fehling's test for sugar in the urine.* (*May, 1901.*)

540. (g) *How should the presence of sugar in a sample of suspected urine be determined?* (*January, 1896.*)

541. (g) *Give in detail a test for ascertaining the presence of sugar in the urine.* (*May, 1897.*)

542. (g) *Give a test for ascertaining the presence of sugar in the urine.* (a) *What kind of sugar is found in the urine?* (*January, 1901.*)

543. (h) *Give a test for recognizing sugar in urine, explaining the chemical changes occurring.* (*May, 1899.*)

544. (g) *Describe a test for sugar in urine.* (*November, 1892.*)

545. (g) *Describe* two *tests for glucose.* (*May, 1898.*)

546. (i) *Describe and explain Trommer's test for sugar.* (*September, 1893.*)

547. (i) *Describe Trommer's test for sugar.* (*March, 1892.*)

548. (g) *Mention a test for sugar other than Trommer's.* (*November, 1891.*)

536 to 548. (a) Glucose; (b) High specific gravity; (c) Low specific gravity; (d) For sugar, see Q. 544; for albumin, see Simon's Manual of Chemistry, pages 569 and 570, etc. (e) Pale color; high specific gravity, 1025 to 1045, or even higher; sweetish odor. (f) Simon's Manual

of Chemistry, page 577; (g) pages 576 and 577, etc.; (h) page 578 (Böttger's test); (i) page 577.

549. Explain a test for the recognition of bile in the urine. (*May, 1893.*)

550. Give a test for the recognition of bile in the urine. (*May, 1896.*)

549 and 550. Simon's Manual of Chemistry, pages 582 and 583.

551. (a) *Of what are the common forms of urinary calculi composed?* (*November, 1892.*)

552. (a) *What is the composition of common forms of urinary calculi?* (*May, 1896.*)

553. (a) *What is the usual chemical composition of urinary calculi?* (*January, 1900.*)

554. (b) *Give the composition of* three *of the most common forms of urinary calculi.* (*June, 1895.*)

555. (a) *Give in order of frequency the possible chemical composition of urinary calculi.* (*June, 1897.*)

556. (c) *Explain the formation of a vesical calculus having a uric acid nucleus.* (*January, 1901.*)

557. (d) *What reaction of the urine favors the deposition of uric acid gravel or calculi?* (e) *What is the reaction of the urine during the formation of a phosphatic calculus?*

551 to 557. (a) Simon's Manual of Chemistry, page 586 (last three lines) and page 585; (b) page 585; (c) "It is generally derived from a pre-existing 'gravel,' which may exist as a persistent 'brick dust' deposit (excess of urates), or from a conglomeration of uric acid crystals passed in masses from the kidney, which may vary in size from a small crumb to the size of a pea. The bladder may expel the calculus through the urethra before it has reached a size too large to be passed; but if this does not occur, the stone increases in bulk by the deposit on its surface of more urates or phosphates, and may in the course of time become a very formidable affair." (Chetwood's *Genito-urinary*

and Venereal Diseases, page 116.) (d) Markedly acid; (e) Alkaline, or very much less acid than normal.

2. Blood.

558. What is the chemical composition of the blood? (*June 1895.*)

559. What are the principal chemical constituents of blood? (*September, 1893.*)

560. State the solids contained in normal blood. What proportion do the solids bear to the water in the blood? (*April, 1897.*)

558 to 560. Simon's Manual of Chemistry, page 506, Plasma. Page 508, Red blood corpuscles. Mineral salts: chlorides, phosphates, and carbonates of sodium, potassium, iron, calcium, magnesium.

561. (a) *What is hæmoglobin?* (b) *On what does its color depend?* (*April, 1899.*)

561. (a) Simon's Manual of Chemistry, pages 484 and 508. The formula has been given as:

$$C_{800}H_{960}N_{154}S_2FeO_{170}$$

(b) On the iron in combination.

3. Bone.

562. What is the chemical composition of bone? (*September, 1896.*)

563. What are the chemical components of bone? (*September, 1894.*)

564. What inorganic salts enter into the formation of human bone? (*May, 1898.*)

562 to 564. Simon's Manual of Chemistry, page 512.

565. What is the difference in the chemical composition of (a) *bone and* (b) *muscle?* (*March, 1892.*)

566. Mention the principal constituents of (a) *bone,* (b) *muscle,* (c) *hair.* (*May, 1899.*)

565 and 566. (a) Simon's Manual of Chemistry, page 512; (b) pages 514 and 515; (c) Carbon, hydrogen, nitrogen, oxygen, sulphur, cholesterin.

4. Bile.

567. (a) *What is the chemical composition of the bile?* (*July, 1893.*)

568. (a) *Mention the principal chemical constituents of bile.* (*April, 1898.*)

569. (b) *Describe a test for biliary acids.* (*June, 1902.*)

567 to 569. (a) Simon's Manual of Chemistry, page 532; (b) page 534.

570. Name the chemical constituents of biliary calculi. (*November, 1891.*)

571. What are the chemical constituents of biliary calculi? (*May, 1894.*)

572. What are the chemical constituents of biliary calculi? (*April, 1896.*)

573. What is the composition of biliary calculi? (*May, 1897.*)

574. What is the composition of gallstone? (*May, 1899.*)

570 to 574. Simon's Manual of Chemistry, page 534.

5. Milk.

575. (a) *What are the principal chemical constituents of milk?* (*June, 1894.*)

576. (b) *Give the comparative constituents of cows' milk and human milk as relating to water, fat, sugar, albuminoids.* (*June, 1896.*)

577. (c) *What albuminoid substance is peculiar to milk?* (d) *Give the properties of this substance.* (e) *Mention the changes that take place in milk when exposed, and state how these changes may be prevented.* (*June, 1902.*)

578. (f) *In what respect does sterilized milk differ chemically from raw milk?* (*June, 1895.*)

579. (g) *Define Pasteurization,* (h) *modified milk.* (*September, 1901.*)

580. (e) *Give a chemical explanation of the souring and curdling of milk.* (*May, 1894.*)

575 to 580. (a) Simon's Manual of Chemistry, page 541; *(b) page* 541; (c) Caseinogen; (d) Simon's Manual of

Chemistry, page 543. (e) Under the influence of the bacterium of lactic acid, the lactose of the milk ferments and is changed into lactic acid. This change in the chemical reaction precipitates the caseinogen into casein, forming the curd. And see Simon's Manual of Chemistry, pages 545 and 546. (f) "According to Leeds, the following alterations are produced in milk by sterilization at 212° F.: 1. The amylolytic ferment is destroyed. 2. The casein coagulates less readily by reunion. 3. The digestibility of casein by the gastric and pancreatic juices is somewhat retarded. 4. The fat is less promptly absorbed than normally from the intestine. 5. If the heating is continued for some time, the milk-sugar is destroyed. The mineral salts of milk are also dissociated in some degree from their organic compounds." (Thompson's *Practical Dietetics.*) (g) *Pasteurization* is the process of heating milk for a period of twenty minutes to a temperature of from 167° F. to 170° F. (h) *Modified milk* is milk the percentages of whose constituents have been changed to conform to those of human milk.

6. Miscellaneous.

581. What salts form the tartar deposited on the teeth? From what source is the tartar derived? (April, 1897.)

581. Simon's Manual of Chemistry, page 514.

582. What chemical changes take place as a result of muscular activity? (June, 1894.)

582. Increased consumption of oxygen, increased output of carbon dioxide and water, development of sarcolactic acid, reaction becomes acid, and slight increase of urea.

583. What is the chemical composition of fat? (March, 1892.)

583. Simon's Manual of Chemistry, pages 404 and 405.

584. Mention a secretion of the body that contains (a) *cholesterin,* (b) *pepsin,* (c) *trypsin. (May, 1898.)*

584. (a) Bile; (b) Gastric juice; (c) Pancreatic juice.

585. What is the normal reaction of (a) *saliva,* (b) *bile? What causes the reaction?* (*May, 1893.*)

586. What is the reaction of normal (a) *saliva,* (c) *blood,* (d) *urine?* (*May, 1894.*)

587. What is the chemical reaction of normal (e) *gastric juice,* (f) *pancreatic juice,* (a) *saliva,* (c) *blood,* (d) *urine?* (*September, 1896.*)

588. Give the chemical reaction of (a) *saliva,* (e) *gastric juice,* (d) *urine.* (*April, 1898.*)

589. What is the normal chemical reaction of (a) *saliva,* (e) *gastric juice,* (f) *pancreatic juice,* (c) *blood,* (g) *tears?* (*September, 1897.*)

585 to 589. (a) "Faintly alkaline because of the Na_2CO_3 which it contains." (Hall's *Physiology.*) (b) Alkaline, due to the presence of trisodic phosphate and of sodium carbonate; (c) Alkaline; (d) Acid; (e) Acid; (f) Alkaline; (g) Alkaline.

590. Mention the principal constituents of the several digestive secretions, and give the reaction of each. (*May, 1900.*)

590.

Secretion.	Reaction.	Composition.
Saliva	Alkaline	See Simon's Manual of Chemistry, page 521
Gastric juice . .	Acid	" " " " " 523
Pancreatic juice .	Alkaline	" " " " " 530
Bile	"	" " " " " 532

591. Mention the acid constituents of (a) *the gastric juice,* (b) *the urine,* (c) *the bile.*

591. (a) Hydrochloric acid, HCl; (b) Acid sodium phosphate, NaH_2PO_4; (c) (Salts of) glycocholic and taurocholic acids.

592. What is the chemical purpose of administering lithium compounds in diseases attended with excessive formation of uric acid? (*April, 1894.*)

593. On what chemical theory are the salts of lithium prescribed in cases presenting a uric acid diathesis? (April, 1896.)

592 and 593. See Q. 213 (c).

594. Give the chemical reason why diabetics should abstain from starchy foods. (June, 1894.)

594. Starches are, during the process of digestion, changed into glucose, which the system of the diabetic patient cannot utilize, and which, therefore, increases the percentage of glucose excreted in the urine.

595. How are the phosphates produced in the animal body? (June, 1901.)

595. By the oxidation of those albuminous constituents which contain phosphorus, and the immediate reaction of the nascent phosphoric acid upon the earthy and alkaline carbonates found in the tissue-fluids.

596. What chemical changes take place in the body after death? (April, 1898.)

597. What chemical changes take place in decaying bodies? (November, 1894.)

598. What gas is given off in the decomposition of animal matter? (June, 1892.)

596 to 598. Simon's Manual of Chemistry, pages 502 and 503.

III. EQUATIONS.

Complete the following equations:

599. (a) $2NH_4Cl + Ca(HO)_2 =$

(b) $2KNO_2 + H_2SO_4 =$

(September, 1893.)

600. (c) $CaCl_2 + Na_2CO_3 =$

(d) $(C_2H_5)HO + C_2H_5HSO_4 =$

(November, 1893.)

601. (e) $CaCl_2 + Na_2CO_3 =$

(April, 1894.)

602. (f) $CaCO_3 + 2HCl =$

(November, 1894.)

603. (g) $CaCl_2+(NH_4)_2CO_3=$
(h) $CH_4N_2O+2H_2O=$
(*September, 1895.*)

604. (i) $C_2H_5Cl+AgHO=$
(j) $CaCO_3+2HCl=$
(*May, 1896.*)

605. (k) $C_2H_5OH+NaC_2H_3O_2+H_2SO_4=$
(*May, 1897.*)

606. (l) $NaC_2H_3O_2+NaOH=$
(*May, 1898.*)

607. (m) $CH_3I+HKS=$
(n) $CS_2+2H_2O+6Cu=$
(*January, 1899.*)

608. (o) $CuSO_4+2KOH=$
(p) $NaHCO_3+HCl=$
(*May, 1900.*)

609. (q) $AgNO_3+NaCl=$
(r) $SiO_2+HF=$
(*June, 1900.*)

610. (s) $FeCl_3+3NH_4OH=$
(t) $MgCl_2+NH_4Cl+Na_3PO_4=$
(*September, 1900.*)

611. (u) $PCl_3+3H_2O=$
(v) $2NaCl+MgSO_4=$
(*May, 1901.*)

612. (w) $MnO_2+4HCl=$
(x) $Fe_3Br_8+4K_2CO_3=$
(*January, 1902.*)

613. (y) $K_2CO_3+Ca(HO)_2=$
(z) $CH_4+Cl_2=$
(*June, 1902.*)

599 to 613. (a) $CaCl_2+2H_2O+2NH_3$
(b) $2HNO_3+K_2SO_4$
(c) $CaCO_3+2NaCl$
(d) $(C_2H_5)_2O+H_2SO_4$
(e) $CaCO_3+2NaCl$
(f) $CaCl_2+H_2O+CO_2$

(g) $CaCO_3+2NH_4Cl$
(h) $2NH_3+CO_2+H_2O$, or $=(NH_4)_2CO_3$
(i) $C_2H_5OH+AgCl$
(j) $CaCl_2+H_2O+CO_2$
(k) $NaHSO_4+(C_2H_5)C_2H_3O_2+H_2O$
(l) $Na_2CO_3+CH_4$
(m) $(CH_3)HS+KI$
(n) $2Cu_2S+2CuO+CH_4$
(o) $K_2SO_4+Cu(OH)_2$; and on boiling $(CuOH)_2=CuO+H_2O$.
(p) $NaCl+H_2O+CO_2$
(q) $AgCl+NaNO_3$
(r) NOTE. $SiO_2+4HF=SiF_4+2H_2O$
(s) $3NH_4Cl+Fe(OH)_3$
(t) $3NaCl+MgNH_4PO_4$
(u) H_3PO_3+3HCl
(v) NOTE. $4NaCl + 2MgSO_4 = 2NaCl + Na_2SO_4+MgCl_2+MgSO_4$
(w) $MnCl_2+2H_2O+Cl_2$
(x) $8KBr+Fe_3(CO_3)_4$
(y) $CaCO_3+2KOH$
(z) $CH_3Cl+HCl$

Complete the following equations and write the name of each resulting compound under its formula:

614. (a) $2NaCl+H_2SO_4=$
(b) $CaCO_3+2HCl=$
(*January, 1894.*)

615. (c) $C_2H_5Cl+AgHO=$
(d) $Sb_2S_3+6HCl=$
(*January, 1895.*)

616. (e) $Ca(HO)_2+CO_2=$
(f) $NaC_2H_3O_2+NaHO=$
(*April, 1895.*)

617. (g) $C_2HCl_3O+NaHO=$
(h) $Pb(NO_3)_2+K_2CrO_4=$
(*May, 1895.*)

618. (i) $As_2O_3+3H_2S=$
(j) $H_2SO_4+NaNO_3=$
(*June, 1895.*)

619. (k) $C_2HCl_3O+KOH=$
(*January, 1897.*)

620. (l) $2C_2H_3KO_2+H_2SO_4=$
(*June, 1897.*)

621. (m) $HgSO_4+Hg+2NaCl=$
(n) $FeSO_4+2NaHCO_3=$
(*September, 1897.*)

622. (o) $2NaCl+Ag_2SO_4=$
(p) $BaO_2+CO_2+H_2O=$
(*January, 1900.*)

614 to 622. (a) $Na_2SO_4 + 2HCl$
Sodium sulphate or disodic sulphate. Hydrochloric acid.

(b) $CaCl_2 + CO_2 + H_2O$
Calcium chloride. Carbon dioxide. Water.

(c) $C_2H_5OH + AgCl$
Ethyl alcohol. Silver chloride.

(d) $2SbCl_3 + 3H_2S$
Antimony trichloride. Hydrogen sulphide.

(e) $CaCO_3 + H_2O$
Calcium carbonate. Water.

(f) $Na_2CO_3 + CH_4$
Sodium carbonate or disodic carbonate. Methane.

(g) $CHCl_3 + Na.COOH.$
Chloroform. Sodium formate.

(h) $PbCrO_4 + 2KNO_3$
Lead chromate. Potassium nitrate.

(i) $As_2S_3 + 3H_2O$
Arsenic trisulphide. Water.

(j) $NaHSO_4$ + HNO_3
Monosodic sulphate or sodium bisulphate. Nitric acid.

(k) $CHCl_3$ + $K.COOH$
Chloroform. Potassium formate.

(l) K_2SO_4 + $2C_2H_4O_2$
Potassium sulphate. Acetic acid.

(m) Na_2SO_4 + Hg_2Cl_2
Sodium sulphate. Mercurous chloride (*or* calomel).

(n) Na_2SO_4 + $FeCO_3$ + CO_2 + H_2O
Sodium sulphate. Ferrous carbonate. Carbon dioxide. Water.

(o) Na_2SO_4 + $2AgCl$
Sodium sulphate. Silver chloride.

(p) H_2O_2 + $BaCO_3$
Hydrogen dioxide. Barium carbonate.

IV. CALCULATIONS.

623. Describe the theory of the construction of the metric system. (May, 1894.)

623. The *metre* (upon which the system is based) is $\frac{1}{40000000}$ of the earth's meridian at Paris, = 39.3 inches. It is divided into tenths, hundredths, and thousandths, designated respectively decimetre, centimetre and millimetre; it is also multiplied by 10, 100, and 1000, and called respectively decametre, hectometre, and kilometre.

For measures of weight, a cubic centimetre of pure water at 4° C. is taken as the unit, and is designated a gramme. Its divisions and multiples are similar to those of the metre.

The unit of volume is the litre; it contains 1000 cubic centimetres; and its divisions and multiples are arranged and named as those of the metre.

624. (a) *How many grammes are there in a hectogramme?* (b) *How many scruples are contained in one pound? (May, 1895.)*

624. (a) One hectogramme = 100 grammes; (b) One pound = 12 ounces = 96 drachms = 288 scruples.

625. (a) *Give the equivalent in apothecaries' weight of 23 centigrammes.* (b) *Express six ounces in the metric system.* (*January, 1896.*)

625. (a) One gramme = approximately $15\frac{1}{2}$ grains $\therefore$ 23 centigrammes = $\frac{23}{100}$ gramme = $(\frac{23}{100} \times \frac{31}{2})$ grains = *approximately* $3\frac{1}{2}$ GRAINS; (b) One ounce = 30 c.c., approximately; $\therefore$ 6 ounces = 180 c.c., approximately.

626. Express in Troy weight the equivalent of (a) *one decigramme,* (b) *three grammes.* (*September, 1896.*)

626. (a) One decigramme = $\frac{1}{10}$ gramme = $(\frac{1}{10} \times \frac{31}{2})$ grains = $1\frac{1}{2}$ GRAINS, *approximately;* (b) 3 grammes = $3 \times 15\frac{1}{2}$ grains = $46\frac{1}{2}$ GRAINS, *approximately.*

627. (a) *Express in cubic centimetres of distilled water the value of one ounce avoirdupois.* (b) *How many minims does a cubic centimetre contain?* (*April, 1897.*)

627. (a) One ounce = *approximately* 30 c.c.

(b) One c.c. = *approximately* 16 MINIMS.

628. State approximately the equivalent: (a) *in grains, of one gramme;* (b) *in fluid ounces, of one litre;* (c) *in inches, of one metre.* (*November, 1893.*)

628. (a) One gramme = $15\frac{1}{2}$ GRAINS, *approximately.*

(b) One litre = $33\frac{1}{2}$ OUNCES, *approximately.*

(c) One metre = 39 INCHES, *approximately.*

629. Express the equivalents of (a) *one litre and* (b) *one metre in units of another system, and express the equivalent of* (c) *one gramme in units of Troy weight.* (*November, 1894.*)

629. (a) See Q. 628 (b).

(b) See Q. 628 (c).

One litre is a little more than a U. S. quart; and one metre is a little more than a yard.

(c) See Q. 628 (a).

630. Transpose the following prescription into the metric system:

℞.—*Amm. mur.,* *three scruples.*
Ext. taraxac., *one-half ounce.*
Succ. liquirit., *three drachms.*
Aquæ destil., *q. s. ad* *two ounces.*
D. S.—One drachm after each meal.
Misce.

(*July, 1893.*)

630.

	Almost exact equivalent.	Ordinarily accurate approximation.
℞.—Ammon. mur.	3.8	4
Ext. taraxac.	15.5	16
Succ. liquirit.	11.6	12
Aquæ destil. . . . q. s. ad .	62.2	64
Misce. D.S. . . . 3.8 after each meal		4

Note.—The second column is accurate enough for all practical purposes.

631. (a) *What temperature Fahrenheit is equivalent to a temperature of 28° Centigrade?* (b) *What temperature Centigrade is equivalent to a temperature of 120° Fahrenheit?* (*June, 1899.*)

631. (a) $F. = (C. \times 1.8) + 32$
$= (28 \times 1.8) + 32$
$= 50.4 + 32 = 82.4$
$\therefore 28° C. = 82.4° F.$

(b) $C. = \frac{F. - 32}{1.8}$
$= \frac{120 - 32}{1.8} = \frac{88}{1.8} = 48.9$ nearly
$\therefore 120° F. = 48.9° C.$ NEARLY

See Simon's Manual of Chemistry, page 37, small print.

632. (a) *Describe the method of preparing H by the action of Na on H_2O.* (b) *Write the formula for the reaction, and find how many grammes of H, 82 grammes of Na would make by this process.* (*September, 1894.*)

632. (a) Simon's Manual of Chemistry, page 117.

(b) $Na_2 + 2H_2O = 2NaOH + H_2$
$46 \qquad\qquad 2.$

46 grammes of Na give 2 grammes of H
$\therefore$ 1 gramme of Na will give $\frac{2}{46}$ gramme of H
and 82 grammes of Na will give $\frac{2 \times 82}{46}$ grammes of H
$= 3\frac{1}{23}$ GRAMMES OF H.

633. Find (a) *the weight and* (b) *the volume of H contained in 17 grammes of* NH_3. (*September, 1896.*)

633. (a) NH_3.

$\overbrace{14.3}^{17}$ In 17 grammes of NH_3 there are 3 GRAMMES OF H

(b) One gramme of H measures 11.16 litres
$\therefore$ 3 grammes of H measures (11.16×3) litres
$= 33.48$ LITRES

See Simon's Manual of Chemistry, page 119, first line.

634. How much water vapor will be formed by the union of 500 cubic centimetres of hydrogen and 250 cubic centimetres of oxygen? (*May, 1895.*)

634. $2H_2 + O_2 = 2H_2O$

That is, 2 vols. H + 1 vol. O = 2 vols. water vapor.
$\therefore$ 500 c.c. H + 250 c.c. O will give 500 C.C. OF WATER VAPOR.

635. What is the percentage composition of $NaNO_3$? (*June 1896.*)

635. $NaNO_3$.

Na =		23
N =		14
O_3 =	16×3 =	48
		85

85 parts by weight of $NaNO_3$ contain 23 parts of Na; we have to find what 100 parts would contain.

As 85 : 100 :: 23 : 27 + PARTS OF Na
Similarly 85 : 100 :: 14 : 16 + PARTS OF N
and 85 : 100 :: 48 : 56 + PARTS OF O

636. What is the per cent. of each constituent present in sulphuric acid, the atomic weight of sulphur being 32? (June 1894.)

636. H_2SO_4.

$H_2 = 1 \times 2 = 2$
$S = 32$
$O_4 = 16 \times 4 = 64$
98

98 parts by weight of H_2SO_4 contain 2 parts of H; we have to find what 100 parts would contain.

As 98 : 100 :: 2 : 2 + PARTS OF H
Similarly 98 : 100 :: 32 : 32 + PARTS OF S
And 98 : 100 :: 64 : 65 + PARTS OF O

Both Q. 635 and 636 can be worked out by the method employed in Q. 632 (b).

637. How much water would be required to yield 100 grammes of hydrogen? (April, 1895.)

637. $H_2O = H_2 + O$
$\underbrace{2.16}_{18}$ 2.

2 grammes H are given by 18 grammes of H_2O
1 gramme H is given by 9 grammes of H_2O
and 100 grammes H are given by 900 GRAMMES OF H_2O.

638. Write a reaction for making barium sulphate from sodium sulphate. How many grains of sodium sulphate are required to yield 2.33 grammes of barium sulphate by this process? [Atomic weight of barium = 137.] (January, 1901.)

638. $Na_2SO_4 + BaCl_2 = 2NaCl + BaSO_4$
$\underbrace{46. 32. 64}_{142}$ $\underbrace{137. 32. 64}_{233}$

Thus, 233 grammes of $BaSO_4$ are given by 142 grammes of Na_2SO_4
$\therefore$ 2.33 grammes of $BaSO_4$ are given by 1.42 grammes of Na_2SO_4.

639. The skeleton of a man weighs 24 pounds and contains 58 per cent. of calcium phosphate, $Ca_3(PO_4)_2$. Find the weight of phosphorus present. [*Atomic weight of Ca=40; of P=31.*] (*May, 1894.*)

639. $Ca_3(PO_4)_2 = Ca_3P_2O_8$

$$\underbrace{120.\ 62.\ 128}_{310}$$

The P present is $\frac{62}{310}$ or $\frac{1}{5}$ of the $Ca_3(PO_4)_2$. Now, as the $Ca_3(PO_4)_2$ is 58 per cent. of the skeleton, and the skeleton weighs 24 pounds, the amount of P = ($\frac{1}{5}$ of $\frac{58}{100}$ of 24) pounds = 2.784 POUNDS OF P.

V. GENERAL CHEMISTRY AND MISCELLANEOUS.

640. What is chemical affinity? (*June, 1893.*)

641. What is chemical affinity? (*November, 1892.*)

642. What is chemical affinity, and give an example. (*September, 1892.*)

640 to 642. Simon's Manual of Chemistry, page 72.

643. What is an atom? (*November, 1892.*)

643. Simon's Manual of Chemistry, page 73.

644. What is a molecule? (*September, 1892.*)

644. Simon's Manual of Chemistry, page 73.

645. Give a statement of the atomic theory. (*March, 1893.*)

646. What is the atomic theory? (*May, 1893.*)

647. State the atomic theory. (*January, 1899.*)

645 to 647. The atomic theory, put forth in modern times by Dalton in 1807, is based on ideas held by the Greek philosopher Democritus, viz., that matter is not infinitely divisible, but that hard atoms of varied shapes and all in rapid motion are the ultimate division. Dalton "rendered the idea more precise by ascribing to these atoms real magnitude and a definite weight, and by considering elementary substances as made up of atoms of the

same kind, and compounds as consisting of atoms of different kinds." (Witthaus' *Manual of Chemistry.*)

648. (a) *What is meant by atomic weight?* (*November, 1892.*)

649. (b) *What is the difference between atomic weight and specific gravity?* (*September, 1893.*)

650. (c) *What is the method of determining the atomic weight of an element?* (*May, 1893.*)

651. (c) *Describe methods for determining atomic weight.* (*September, 1897.*)

652. (c) *How is the weight of an atom of a given substance obtained?* (*June, 1898.*)

648 to 652. (a) Simon's Manual of Chemistry, page 74; (b) Atomic weight is the weight of an *atom* of an element as compared with the weight of an *atom* of hydrogen. Specific gravity (of a gas) is the relative weight of equal volumes of that gas and a standard gas (air or hydrogen). Reduced to prime factors it is the weight of a *molecule* of the gas compared with the weight of a *molecule* of hydrogen.; (c) Simon's Manual of Chemistry, pages 81, 82 and 83. But note that the *absolute* weight of an atom of any element is unknown; its *comparative* or *relative* weight is known.

653. What is (a) *an element?* (b) *a compound?* (c) *a mixture?* (*November, 1894.*)

654. Differentiate (d) *a mass of matter,* (b) *a chemical compound, and* (a) *an elementary body.* (*May, 1899.*)

655. (b) *What is meant by a chemical compound?* (*September, 1893.*)

656. Explain the difference between (c) *a chemical mixture and* (b) *a chemical compound, and give an example of each.* (*September, 1892.*)

657. State what is meant by (c) *the term mixture, and distinguish it from the* (b) *term compound, giving examples of each.* (*January, 1894.*)

653 to 657. (a) Simon's Manual of Chemistry, page 71; (b) pages 71 and 75; (c) pages 75 and 76; (d) page 18.

Note that a mass may be an element, a compound, or a mixture.

658. (a) *What is a chemical symbol?* (*March, 1893.*)

659. (a) *What is a chemical symbol?* (b) *Give the symbols of ten elements.* (*November, 1893.*)

660. (b) *Name twenty known elements, giving the chemical symbol of each.* (*June, 1894.*)

661. (b) *Give the symbol of antimony, silver, gold, iron, zinc.* (*September, 1892.*)

662. (b) *Give the symbols of the following elements: gold, silver, iron, arsenic, potassium.* (*June, 1893.*)

663. (b) *Give the symbol and* (c) *the valence of* each *of the following: hydrogen, oxygen, nitrogen, carbon, gold, iron, mercury, potassium.* (*May, 1898.*)

664. Give (b) *the symbol,* (d) *atomic weight, and* (c) *valence of each of ten elements.* (*January, 1898.*)

665. (b) *Give a list of twenty elements with their symbols and* (e) *write an equation showing the union of two or more elements to form a compound.* (*January, 1896.*)

658 to 665. (a) Simon's Manual of Chemistry, page 74; (b) page 595; (c) pages 110 and 177; (d) page 595; (e) $H_2 + Cl_2 = 2HCl$. See page 89.

666. (a) *Explain the use of symbols and formulas.* (b) *Give and translate* five *examples of each.* (*June, 1895.*)

667. (b) *Write the symbol of each of ten elements, and the formula of each of five compounds, giving the name in each case.* (*January, 1901.*)

666 and 667. (a) Simon's Manual of Chemistry, page 74; (b) For symbols, see page 595. For formulas, see Q. 746 to 755.

668. Illustrate the differences between (a) *an empiric formula and* (b) *a molecular formula.* (*September, 1899.*)

669. (c) *What is a* graphic formula? (d) *Give* five *illustrations.* (*May, 1895.*)

670. (d) *Give three illustrations of graphic formulas.* (*September, 1896.*)

671. (e) *Define and illustrate the difference between an empiric formula and a rational chemical formula.* (*January, 1896.*)

672. (e) *Give and explain an empiric formula; a rational formula.* (*September, 1897.*)

668 to 672. (a) Simon's Manual of Chemistry, page 338; (b) page 338; (c) page 339; (d) See Q. 756; (e) Simon's Manual of Chemistry, page 339 (acetic acid).

673. (a) *State the law of definite proportions.* (b) *Differentiate mixture and compound.* (*September, 1900.*)

674. State (a) *the law of definite proportions,* (c) *the law of multiple proportions.* (*September, 1898.*)

675. (d) *Explain and illustrate the law of chemical combination by volume.* (*January, 1897.*)

676. (e) *What are the laws governing the combination of the elements?* (*September, 1894.*)

677. (e) *State two laws governing chemical combinations.* (*April, 1898.*)

673 to 677. (a) Simon's Manual of Chemistry, page 75; (b) page 75; (c) page 76; (d) page 77; (e) See (a), (c), (d).

678. Explain the meaning of the chemical terms: (a) *molecule,* (b) *valence, (equivalence), and* (c) *atomic weight.* (*June, 1894.*)

679. (b) *Define and illustrate quantivalence.* (*September, 1896.*)

680. Give definitions and illustrations of (d) *monad,* (e) *diad, and* (f) *triad elements.* (*May, 1894.*)

681. What is the meaning of the terms (d) monad, (g) tetrad, *and* (h) pentad? *Give an example of each.* (*September, 1895.*)

682. Mention two elements of each of the following groups: (d) *univalent,* (e) *bivalent,* (f) *trivalent,* (g) *quadrivalent.* (*June, 1897.*)

683. (h) *Mention a pentad element, and explain the name.* (*September, 1894.*)

678 to 683. (a) Simon's Manual of Chemistry, pages 73 and 72; (b) page 78; (c) page 74; (d) page 79; (e) page 79; (f) page 79; (g) page 79 (tetrad=a quadrivalent element); (h) Pentad, or quinquivalent element, is an element that combines with hydrogen or other univalent element in the proportion of one atom to five atoms. For examples of (d), (e), (f), (g), (h), see Simon's Manual of Chemistry, pages 110 and 177.

684. Give the names of two (a) elements *or* (b) *radicles in* each *of the following groups: univalent, bivalent, trivalent, quadrivalent. (June, 1899.)*

685. (c) *What is a* compound radicle? (d) *Give* three *examples of compound radicles, indicating the valence of each. (September, 1899.)*

686. State the valence of the following radicles: (e) *CN,* (e) *HO,* (e) NO_2, (f) *CO,* (g) *HC. (January, 1899.)*

684 to 686. (a) Simon's Manual of Chemistry, pages 110 and 177; (b) See Q. 686; (c) page 96; (d) See Q. 686; (e) Univalent; (f) Bivalent; (g) Trivalent.

687. Give examples of the decomposition of compounds by (a) *heat,* (b) *electricity,* (c) *light. (January, 1897.)*

688. Give an illustration of decomposition by (a) *heat,* (b) *electricity,* (c) *light. (September, 1899.)*

689. (b) *Explain an experiment to prove that chemical action may be induced by electricity. (January, 1894.)*

690. (c) *Explain an experiment to prove that chemical action may be induced by light. (April, 1893.)*

687 to 690. (a) Simon's Manual of Chemistry, page 72 (last two lines); (b) page 67; (c) page 242.

691. (a) *What is understood by* chemical reaction? (b) *Give an illustration. (April, 1896.)*

692. (a) *Define* chemical reaction. (b) *Give an illustration. (May, 1896.)*

693. (c) *What is a chemical reagent? (September, 1894.)*

691 to 693. (a) Chemical reaction is the interaction of two or more substances causing a chemical decomposition.

Also, the evidences of chemical decomposition afforded by changes in color, shape, state, solubility; (Duane's Students' Medical Dictionary), and see Simon's Manual of Chemistry, page 89; (b) page 89; (c) page 91.

694. (a) *What is the difference between analytic methods and synthetic methods in chemistry?* (*June, 1897.*)

695. (a) *What is synthesis?* (b) *How has its application been of use in medicine?* (*April, 1897.*)

696. (c) *Give an example of a synthetic operation.* (*January, 1894.*)

694 to 696. (a) Simon's Manual of Chemistry, pages 91 and 92; (b) All inorganic medicinal compounds not found free in nature are produced by synthesis. It has been most notably employed in organic chemistry, in the preparation of the coal-tar products, as acetanilid, phenacetin, and many others. See Q. 440 (a). Chloroform, ether, and iodoform are also examples of synthesis. (c) Burning carbon in air or oxygen. If carbon is burned in a limited amount of air or O the result is CO; if in a more abundant supply, CO_2 is produced.

697. Define (a) reaction, (b) reagent, (c) acid, (d) base, (e) salt. (*September, 1900.*)

698. (c) *What is an acid?* (*January, 1893.*)

699. Define (c) *an acid,* (d) *a base, and* (e) *a salt.* (*November, 1891.*)

700. (f) *Describe and illustrate monobasic acid, dibasic acid, tribasic acid.* (*September, 1895.*)

701. (g) *Differentiate hydracids and oxyacids.* (*May, 1901.*)

702. What is (h) *a radicle,* (d) *a base,* (c) *an acid,* (e) *a salt?* (*January, 1894.*)

703. Define (h) *radicle,* (i) *basicity of an acid. Illustrate each.* (*September, 1901.*)

704. Define (j) *basic radicle,* (k) *water of hydration,* (b) *reagent,* (l) *acid radicle.* (*May, 1902.*)

705. Define and give an example of each of the following: (m) *binary compound,* (c) *acid,* (n) *hydrate,* (e) *salt.* (*September, 1894.*)

706. (c) *What are acids? and* (o) *how are salts formed from them?* (*May, 1893.*)

697 to 706. (a) See Q. 692; (b) Simon's Manual of Chemistry, page 91; (c) page 92; (d) page 92; (e) page 95; (f) page 92; (g) A hydracid is an acid that contains no oxygen, as HF, HCl, HCN. An oxyacid is an acid that contains oxygen as well as hydrogen, as HNO_3, HCNO. (h) Simon's Manual of Chemistry, page 96; (i) By the basicity of an acid we mean the number of replaceable atoms of hydrogen which it contains. See Simon's Manual of Chemistry, page 92. (j) A basic radicle is a group of atoms acting as a base; thus, in $(NH_4)NO_3$, (NH_4) is the basic radicle. (k) Water of hydration is the chemically combined water in a compound. H_4SO_4 *minus* its water of hydration $= SO_3$. (l) An acid radicle is that group of atoms in an acid which combines as a unit in a chemical reaction; thus, in the reaction $AgNO_3 + NaCl = AgCl + NaNO_3$, the acid radicle is NO_3. (m) A binary compound is one that is composed of two elements only, as NaCl. (n) 1. A hydrate is a compound which contains water in chemical combination; thus, H_2SO_4 is SO_3 chemically combined with H_2O. 2. A hydrate is considered by some writers as equivalent to a hydroxide. See Simon's Manual of Chemistry, page 92. (o) page 95.

707. (a) *Explain the nomenclature of binary compounds.* (b) *Which element is to be placed first, and* (c) *how is the termination of the second to be altered?* (*September, 1897.*)

708. (d) *Give a rule for the nomenclature of acids and of their salts.* (*April, 1897.*)

709. (e) *Illustrate the comparative significance of the following affixes:* ous, ic, ite, ate. (*June, 1899.*)

710. Describe the significance of the affixes (f) *id* (*ide*); (e) *ate*; (e) *ite. Give examples of each.* (*June, 1893.*)

711. (g) *What is a salt? How is a salt formed? State the*

difference between the affixes (f) id *and* (e) ate, *and give an illustration of each.* (*January, 1902.*)

712. Explain and give examples as used in chemistry of (h) *the prefixes hypo, per*; (e) *the suffixes ic, ous.* (*September, 1893.*)

713. (i) *What is the meaning of the prefix* sesqui *in chemical nomenclature?* (*January, 1892.*)

714. Describe the significance of the prefixes (j) sub, (i) sesqui, (k) mon, *and give examples of each.* (*April, 1894.*)

715. Explain the significance of the following suffixes and affixes: (l) hydro, (j) sub, (m) hyper, (n) nitro, (o) bi, (e) ous, (e) ic, (e) ate, (e) ite. (*January, 1901.*)

716. (p) *How are the compounds containing two, three, or four elements distinguished by name? Define* (q) *hydroxide,* (r) *hydrate.* (*September, 1902.*)

717. (s) *Explain the difference between a sulphate and a sulphite.* (*May, 1896.*)

718. (t) *Differentiate nitrates and nitrites.* (u) *Mention* two *compounds of each group commonly used in medicine.* (*April, 1899.*)

707 to 718. (a) Simon's Manual of Chemistry, pages 104 and 105; (b) The more electropositive; (c) Changed to *ide;* (d) Simon's Manual of Chemistry, pages 104 and 105; (e) pages 104 and 105; (f) In binary compounds only. See Simon's Manual of Chemistry, page 104. (g) page 95; (h) When there are more than two acids or salts containing the same elements, *hypo* is prefixed to the compound containing *less oxygen* than the *ous* acid; and *per* is prefixed to the compound containing *more* oxygen than the *ic* acid: Thus:

HClO *Hypochlorous* acid.	NaClO Sodium *hypochlorite.*
$HClO_2$ Chlor*ous* acid.	$NaClO_2$ Sodium chl*orite.*
$HClO_3$ Chlor*ic* acid.	$NaClO_3$ Sodium chl*orate.*
$HClO_4$ *Per*chlor*ic* acid.	$NaClO_4$ Sodium *per*chl*orate.*

(i) *Sesqui* is prefixed to the name of the more electronegative element or radicle to denote that three of the latter are in combination with two of the more electro-

positive atoms or groups. Thus, ferric sesquioxide, Fe_2O_3; ferric sesquicarbonate, $Fe_2(CO_3)_3$. Sesqui literally means one and a half; the ratio in the compounds being 1 : 1½. But as fractions are not permissible, we double these numbers and get the ratio 2 : 3.

(j) *Sub* is prefixed to the name of the more electronegative element or radicle to denote a lesser proportion of it than exists in the normal compound whose name it bears; the deficiency is usually made up by O, or (OH). Thus, $BiONO_3$ = bismuth subnitrate; $Bi(NO_3)_3$ being bismuth nitrate, or normal bismuth nitrate.

(k) *Mon* signifies that there is but one atom of the element to which it is prefixed, in the molecule. Thus, NaH_2PO_4 = *mon*osodic phosphate.

(l) *Hydro* signifies the presence in the compound of hydrogen, and at the same time *the absence of oxygen.* Thus, HCl, hydrochloric acid.

(m) *Hyper* = *per.* See (h).

(n) *Nitro* indicates the presence of the group (NO_2).

(o) *Bi* signifies the presence of two atoms of the element to which it is prefixed, in the compound. Thus, mercury biniodide, HgI_2; mercury bichloride, $HgCl_2$. It is also used to indicate the presence of twice the quantity of the more electronegative element or radicle that is present in the normal, satisfied compound. Thus, Na_2CO_3 = normal sodium carbonate; $NaHCO_3$ = sodium bicarbonate.

(p) Simon's Manual of Chemistry, pages 104 and 105, and Q. 707 to 715.

(q) A hydroxide is a compound made up of water half of whose hydrogen has been replaced by a metal. Thus, H—O—H = water; K—O—H = potassium hydroxide.

(r) See Q. 705 (n).

(s) Simon's Manual of Chemistry, page 105.

(t) Nitrates are salts derived from nitric acid; nitrites are salts derived from nitrous acid.

(u) Potassium nitrate, silver nitrate; amyl nitrite, sodium nitrite.

719. (a) *Name five elements and* (b) *describe the principal properties of each.* (*September, 1893.*)

720. (a) *Mention some of the principal elements.* (*September, 1892.*)

719 and 720. (a) Simon's Manual of Chemistry, page 595; (b) See pages 113, 118, 124, 144, and 164 for properties of O, H, N, S, and Cl, respectively.

721. (a) *What is an element?* (b) *Into what* two *principal groups are elements divided?* (c) *Mention* five *elements that exist uncombined in nature.* (*April, 1899.*)

722. (d) *Explain the difference between metals and non-metals.* (*September, 1897.*)

723. Mention the elements that, under ordinary conditions, exist as (e) *liquids,* (f) *gases.* (*June, 1898.*)

724. (f) *Which of the elements are gases at ordinary temperature and pressure?* (*April, 1894.*)

721 to 724. (a) Simon's Manual of Chemistry, page 71; (b) Metals and non-metals or metalloids, page 98; (c) See Q. 731; (d) Simon's Manual of Chemistry, page 98: (e) pages 102 and 103; (f) page 103.

725. Define positive element, negative element. *Illustrate each.* (*April, 1898.*)

725. Positive element = electropositive element, and negative element = electronegative element. See Simon's Manual of Chemistry, pages 67 and 87.

726. (a) *Name the lightest of all known elements.* (*September, 1892.*)

727. (b) *What is the essential elements of all acids?* (*January, 1902.*)

728. (c) *What element composes over half the matter of the earth?* (*November, 1891.*)

729. (d) *What element constitutes four-fifths of the air?* (*September, 1892.*)

730. (e) *What two principal elements enter into the composition of the air?* (*March, 1892.*)

726 to 730. (a) Hydrogen; (b) Hydrogen; (c) Oxygen; (d) Nitrogen; (e) Nitrogen and Oxygen.

731. Mention the elements existing uncombined in nature? (January, 1900.)

731. Oxygen, hydrogen, nitrogen, carbon, sulphur, arsenic, antimony, bismuth, copper, gold, silver, lead, iron, mercury, tin, platinum.

732. What simple elements are used in medicine? (January, 1895.)

733. Mention six elements used in their pure state in medicine. (April, 1897.)

734. Mention five elementary substances commonly used in medicine in a pure or uncombined state. (January, 1898.)

732 to 734. Oxygen, chlorine, iodine, sulphur, carbon, phosphorus, iron, mercury.

735. (a) *Enumerate the non-metallic chemical elements which, in various combinations, are found in the tissues of the body. (September, 1901.)*

736. (b) *What metal is liquid at ordinary temperature? (January, 1893.)*

737. (c) *What metallic element is constantly present in the coloring matter of the blood? (November, 1892.)*

738. (d) *Which of the metals is the best conductor of electricity? (May, 1893.)*

739. What metal is (e) *the least tenacious,* (f) *the most infusible,* (g) *the best for electromagnets,* (h) *the best for electroconductors,* (i) *the most rare? (June, 1894.)*

740. (j) *Mention the metals whose salts are often taken as poisons. (January, 1901.)*

741. (k) *What metallic chemical elements are found in the body in various combinations? (May, 1901.)*

742. Name and describe (l) *an amalgam,* (m) *an alloy. (November, 1893.)*

743. Define (m) *alloy,* (l) *amalgam. Give an example of each. (January, 1901.)*

735 to 743. (a) Carbon, hydrogen, oxygen, nitrogen, sulphur, phosphorus, chlorine, and occasionally fluorine, bromine, iodine, silicon; (b) Mercury; (c) Iron; (d) Silver; (e) Mercury; (f) Iridium; (g) Iron; (h) Silver (commercially, copper); (i) Radium; (j) Arsenic, copper, lead, mercury, potassium; (k) Iron, potassium, sodium, calcium, magnesium, and occasionally lithium, manganese, aluminum; (l) Simon's Manual of Chemistry, pages 179 and 192; (m) pages 179 and 235.

744. In composition with what element are the following most commonly found in nature: (a) *iron,* (b) *gold,* (c) *silver,* (d) *copper,* (e) *chlorine? (January, 1894.)*

744. (a) Oxygen, carbon; (b) Tellurium; (c) Sulphur; (d) Oxygen, carbon; (e) Sodium.

745. Mention (a) two *substances that are fusible,* (b) two *substances that are volatilized by heat,* (c) two *substances that are unaffected by heat. (September, 1899.)*

745. (a) Tin, lead; (b) Mercury, water; (c) Iridium, zirconium.

746. Give the chemical formulas of (a) *nitric acid,* (b) *sulphuric acid, and* (c) *hydrochloric acid. (January, 1893.)*

747. Give the formula of (b) *sulphuric acid,* (a) *nitric acid,* (c) *hydrochloric acid,* (d) *boracic acid,* (e) *alcohol. (January, 1902.)*

748. Write the formula for (f) *sulphurous acid,* (g) *acetic acid,* (c) *hydrochloric acid,* (h) *water,* (i) *cupric sulphate. (November, 1894.)*

749. What is the formula for (j) *chloroform,* (k) *sulphuric ether,* (e) *alcohol? (January, 1894.)*

750. Give the formula of (e) *ethyl alcohol,* (g) *acetic acid,* (l) *marsh gas,* (m) *aurous acid,* (n) *sodium hydrate. (June, 1896.)*

751. Write the formula of each *of the following:* (c) *hydrochloric acid,* (b) *sulphuric acid,* (a) *nitric acid,* (o) *cupric nitrate,* (p) *calcium sulphate. (May, 1900.)*

752. Write the formulas of (q) *common salt,* (a) *nitric acid,* (b) *sulphuric acid,* (c) *hydrochloric acid,* (r) *carbonic anhydride.* (*November, 1893.*)

753. Write the formulas for (s) *sodium sulphate,* (t) *potassium nitrate,* (u) *ammonium chloride.* (*July, 1893.*)

754. Give the formula for (v) *mercuric chloride,* (w) *sodic sulphate,* (o) *cupric nitrate,* (x) *potassium chlorate,* (y) *calcium carbonate.* (*May, 1893.*)

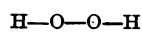
755. Give the chemical name and formula of (h) *water,* (q) *common salt,* (z) *carbonic acid,* (a) *nitric acid.* (*July, 1893.*)

746 to 755. (a) HNO_3; (b) H_2SO_4; (c) HCl; (d) H_3BO_3; (e) C_2H_5OH; (f) H_2SO_3; (g) $C_2H_4O_2$ *or* $CH_3.COOH$; (h) H_2O (hydrogen monoxide); (i) $CuSO_4$; (j) $CHCl_3$; (k) $(C_2H_5)_2O$; (l) CH_4; (m) $HAuO$; (n) $NaHO$; (o) $Cu(NO_3)_2$; (p) $CaSO_4$; (q) $NaCl$ (sodium chloride); (r) CO_2 (carbon dioxide); (s) Na_2SO_4; (t) KNO_3; (u) $(NH_4)Cl$; (v) $HgCl_2$; (w) Na_2SO_4 and $NaHSO_4$; (x) $KClO_3$; (y) $CaCO_3$; (z) H_2CO_3 is carbonic acid, but CO_2 is often (erroneously) called carbonic acid.

756. Write graphic formulas for the following: (a) hydrogen peroxide, (b) *ammonium chloride,* (c) *mercurous chloride,* (d) *ammonia,* (e) *phosphoric acid.* (*May, 1894.*)

756.

(a)



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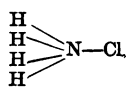
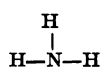
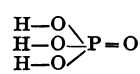


(c)

(d)



(e)



757. (a) *What is an* acid? (b) *Give the names and formulas of* five *acids used in medicine.* (*January, 1900.*)

758. (b) *Express in chemical symbols the formula of some acid used in medicine.* (*January, 1892.*)

759. (b) *Name and give the formulas of five acids commonly used in medicine.* (*September, 1896.*)

760. (b) *Write the formulas and give the names of* five *acid compounds and* (c) *of* five *salt compounds.* (*September, 1895.*)

761. (d) *What acids are commonly used in medicine? Give the formula of each.* (*June, 1895.*)

757 to 761. (a) Simon's Manual of Chemistry, page 92; (b) See Q. 746 to 752, (a), (b), (c), (d), (g); (c) See Q. 746 to 755, (i), (o), (p), (q), (s); (d) See Q. 759 (b), and add benzoic acid, $C_6H_5.COOH$; hydrocyanic acid (diluted), HCN; nitrohydrochloric acid, HNO_3+3HCl; phosphoric acid, H_3PO_4; salicylic acid, $C_6H_4OH.COOH$.

762. Write a chemical equation showing a double decomposition. (*May, 1897.*)

762. $H_2SO_4 + 2NaNO_3 = Na_2SO_4 + 2HNO_3$, and see Simon's Manual of Chemistry, page 89.

763. Define (a) *qualitative analysis, and* (b) *give a principal method.* (*April, 1894.*)

764. Define (a) qualitative analysis, (c) *quantitative analysis.* (d) *Illustrate each.* (*May, 1898.*)

763 and 764. (a) Simon's Manual of Chemistry, page 270; (b) pages 281 to 295; (c) page 270; (d) page 297, and see (b).

765. (a) *What do you understand by an anhydrous substance?* (*January, 1893.*)

766. (b) *What is meant by the water of crystallization?* (*April, 1893.*)

767. (c) *What is effervescence, and* (d) *what is efflorescence?* (*July, 1893.*)

768. Define (d) *efflorescent,* (a) *anhydrous,* (e) *deliquescent,* (f) *analysis,* (g) *synthesis.* (*September, 1901.*)

769. (h) *Name and describe a deliquescent salt.* (*September, 1893.*)

770. Define (a) *anhydrous,* (e) *deliquescent,* (d) *efflorescent,* (i) *electrolysis,* (j) *decantation.* (*September, 1902.*)

765 to 770. (a) An anhydrous substance is one which does not contain any water; (b) Simon's Manual of Chemistry, page 121; (c) Effervescence is motion caused in a liquid by the sudden liberation of a gas; (d) Simon's Manual of Chemistry, pages 121 and 122; (e) page 122; (f) page 91; (g) pages 91 and 92; (h) Zinc chloride. See page 228. (i) pages 67 and 68; (j) Decantation "is the act of pouring a liquid gradually out of a vessel so as to separate it from the sediment which it contains." (Duane's *Students' Medical Dictionary.*)

771. (a) *State the chemical differences between organic and inorganic substances.* (*May, 1897.*)

772. (a) *Describe and illustrate the distinction between organic and inorganic compounds.* (*April, 1899.*)

773. Distinguish between (a) *organic and inorganic substances,* (b) *elementary and compound substances. Give an example of each.* (*June, 1901.*)

771 to 773. (a) Simon's Manual of Chemistry, pages 331 and 332, last paragraph; (b) page 71.

774. (a) *What is litmus and* (b) *what is its use in chemistry?* (*January, 1895.*)

775. (a) *Describe litmus, mentioning its source,* (c) *the form commonly used in the laboratory, and* (b) *its reactions.* (*September, 1902.*)

776. (a) *What is litmus?* (d) *Explain its uses in urinalysis.* (*September, 1895.*)

777. (d) *What is the purpose of litmus paper in urinalysis?* (*November, 1892.*)

778. How does each of the following affect litmus paper: (e) H_2O, (f) H_2SO_4, (g) $(NH_4)OH$. (*April, 1894.*)

774 to 778. (a) "A blue pigment obtained from Rocella tinctoria, a lichen. It is employed for determining the

presence of acids and alkalies" (Gould's Medical Dictionary); (b) Simon's Manual of Chemistry, pages 92 and 305; (c) Litmus paper, see page 305; (d) pages 559 and 560; (e) No effect; (f) Reddens blue litmus paper; (g) Makes red litmus paper blue.

779. State the chemical meaning of the term incompatible. (March, 1893.)

779. Substances are said to be chemically incompatible if on being mixed together they undergo chemical decomposition or form an explosive compound.

780. What is chemical decomposition? (January, 1894.)

780. Simon's Manual of Chemistry, pages 89 and 90.

781. How do chemical antidotes and physiological antidotes differ in action? Illustrate. (June, 1897.)

781. *Chemical antidotes* combine with the noxious substances, producing harmless compounds; thus, $H_2SO_4 + MgO = MgSO_4 + H_2O$. *Physiological antidotes* combat the physiological action of poisons; thus, strychnine stimulates the spinal cord, causing convulsions; potassium bromide depresses the spinal cord and counteracts the former effect.

782. Give reasons from a chemical standpoint for the use of gold and silver for coin. (January, 1897.)

782. Gold and silver are not affected by atmospheric air at any temperature; will practically last indefinitely; such of their salts as might be formed by exposure to sulphur or kindred substances are non-poisonous, and the ordinary acids have no effect on them.

783. (a) *What is the chemical treatment of œsophageal and stomach corrosion from mineral acids?* (b) *Give an argument against the use of the stomach pump in such cases. (April, 1896.)*

783. (a) Simon's Manual of Chemistry, page 150; (b) Perforation may be caused by the stomach pump. The

wall of the stomach and œsophagus being already in part, if not entirely, corroded by the acid, the lightest touch may complete the destruction of the barrier between the stomach and the peritoneum, or between the œsophagus and the surrounding cellular tissues.

784. (a) *What is Paris green?* (*November, 1891.*)

785. (b) *What is the chemical name of Rochelle salt?* (*November, 1891.*)

786. (c) *Give the chemical name of Monsel's salt.* (*June, 1892.*)

787. What is the technical name of (d) *aqua regia,* (e) *aqua fortis,* (f) *oil of vitriol?* (*April, 1893.*)

788. What are the chemical names of (g) *borax,* (h) *plaster of Paris,* (i) *marble,* (j) *blue vitriol,* (k) *saltpetre?* (*September, 1894.*)

789. Give the chemical name for (l) *tartar emetic,* (m) *cream of tartar,* (n) *sugar of lead,* (o) *copperas,* (b) *Rochelle salt.* (*January, 1900.*)

790. Give the chemical name and formula of each of the following: (p) *Epsom salt,* (q) *Glauber's salt,* (l) *tartar emetic.* (*May, 1900.*)

791. Give the chemical name and formula of each of the following: (d) *aqua regia,* (f) *oil of vitriol,* (a) *Paris green,* (r) *sal ammoniac,* (o) *copperas.* (*June, 1900.*)

792. Give the chemical name and properties of (m) *cream of tartar,* (a) *Paris green,* (h) *plaster of Paris.* (*May, 1901.*)

793. Give the chemical name of (s) *common table salt,* (j) *blue vitriol,* (t) *soot,* (u) *vinegar,* (v) *verdigris.* (*June, 1901.*)

794. Give the formula and chemical name of each of the following substances: (x) *indicating those soluble in water:* (k) *nitre,* (p) *Epsom salt,* (w) *lunar caustic,* (a) *Paris green,* (e) *aqua fortis,* (h) *gypsum.* (*June, 1898.*)

795. Give the chemical composition of (q) *Glauber's salt,* (p) *Epsom salt,* (b) *Rochelle salt.* (*April, 1899.*)

784 to 795. (a) Cupric-aceto-metarsenite, $Cu(C_2H_3O_2)_2 + 3CuAs_2O_4$.
(b) Sodium-potassium-tartrate, $NaKC_4H_4O_6$.
(c) Ferric subsulphate.
(d) Nitrohydrochloric acid, $HNO_3 + 3HCl$.
(e) Nitric acid, HNO_3.
(f) Sulphuric acid, H_2SO_4.
(g) Sodium borate or biborate are the names usually given, but as the formula is $Na_2B_4O_7$ disodic tetraborate would be the more correct name.
(h) Calcium sulphate, $CaSO_4$.
(i) Calcium carbonate, $CaCO_3$.
(j) Cupric sulphate, $CuSO_4$.
(k) Potassium nitrate, KNO_3.
(l) Antimony-potassium tartrate (more correctly antimonyl-potassium tartrate), $(SbO).KC_4H_4O_6$.
(m) Monopotassic tartrate, $KHC_4H_4O_6$.
(n) Lead acetate, $Pb(C_2H_3O_2)_2$.
(o) Ferrous sulphate, $FeSO_4$.
(p) Magnesium sulphate, $MgSO_4$.
(q) Sodium sulphate, Na_2SO_4.
(r) Ammonium chloride, NH_4Cl.
(s) Sodium chloride, NaCl.
(t) Carbon.
(u) Acetic acid, (dilute).
(v) A mixture of three different varieties of basic acetates of copper.
(w) Silver nitrate, $AgNO_3$.
(x) Nitre, Epsom salt, lunar caustic, aqua fortis are soluble in water.

796. (a) *What is the composition of Sedlitz powders, and* (b) *what reaction occurs when their solutions are mixed?* (*April, 1896.*)

797. (a) *What is the composition of Sedlitz powders?* (b)

What chemical changes take place when the ingredients of a Sedlitz powder are jointly dissolved? (June, 1897.)

798. (a) *Give the chemical names of the ingredients of a Sedlitz powder, and* (b) *state the reaction resulting from a mixture of the solutions of these ingredients. (May, 1902.)*

799. (b) *Explain the reaction which occurs when the solutions of the two parts of a Sedlitz powder are mixed. (September, 1902.)*

796 to 799. (a) Simon's Manual of Chemistry, page 395; (b) page 395, and see Q. 800 (d).

800. Indicate by chemical signs and symbols the reactions that occur when (a) *a phosphorus match is lighted in the air,* (b) *sodium is placed on the surface of water,* (c) *hydrochloric acid is poured on marble,* (d) *two portions of a Sedlitz powder are mixed in water. (June, 1900.)*

800. (a) There are three things to be considered: (1) the phosphorus burning, (2) the sulphur burning, and (3) the wood or cellulose burning.

(a) (1) $2P_2 + 5O_2 = 2P_2O_5$
(2) $S_2 + 2O_2 = 2SO_2$
(3) $C_6H_{10}O_5 + 6O_2 = 6CO_2 + 5H_2O$

(b) $Na_2 + 2H_2O = 2NaHO + H_2$

(c) $2HCl + CaCO_3 = CaCl_2 + H_2O + CO_2$

(d) $2NaHCO_3 + KNaC_4H_4O_6 + H_2C_4H_4O_6 + [x\ H_2O] = [x\ H_2O] + Na_2C_4H_4O_6 + KNaC_4H_4O_6 + 2H_2O + 2CO_2$

801. Describe the chemical process (a) *when iron rusts,* (b) *when wood burns,* (c) *when silver is tarnished by coal-gas. (June, 1898.)*

801. (a) Oxygen aided by water attacks the iron and forms oxide and hydroxide of iron in varying proportions; (b) See Q. 800 (a), 3; (c) H_2S, which exists as an impurity in coal-gas, directly attacks the silver, producing silver sulphide.

802. Designate the following as chemical or physical changes: (a) *the souring of milk,* (b) *decomposition of sunlight by means of prism,* (c) *converting water into steam,* (d) *dissolving salt in water,* (e) *decay of wood. (March, 1898.)*

802. (a) Chemical; (b) Physical; (c) Physical; (d) Formerly was considered physical, but now (by ionization theory) is considered chemical; (e) Chemical.

803. Define and illustrate (a) *element*, (b) *compound*, (c) *mixture*, (d) *solution*, (e) *precipitate.* (*April, 1894.*)

803. (a) Simon's Manual of Chemistry, page 71; (b) pages 71 and 75; (c) page 75; (d) *Solution* is a molecular mixture of a liquid with a gas, a solid, or another liquid in such a proportion that the resultant is a liquid; (e) *Precipitate* is the formation in the body of a solution of a substance insoluble in the liquid under the existing conditions.

804. Explain the terms (a) amorphous, (b) alkali, (c) water of crystallization, (d) amalgam, (e) nascent state. (*September, 1894.*)

804. (a) Simon's Manual of Chemistry, page 20; (b) An *alkali* is the hydroxide of the so-called alkaline metals. See page 180. It is strongly basic. (c) page 121; (d) page 179; (e) page 91.

805. Define (a) adhesion, (b) cohesion, (c) capillary attraction, (d) osmosis, (e) saturation. (*January, 1895.*)

805. (a) Simon's Manual of Chemistry, page 28; (b) page 18; (c) page 29; (d) page 31; (e) *Saturation* is the point at which a liquid cannot dissolve more of a given substance under the existing conditions of temperature and pressure.

806. Define (a) evaporation, (b) distillation, (c) filtration, (d) annealing, (e) hard waters. (*April, 1895.*)

806. (a) *Evaporation* is the slow conversion of liquid into vapor, without ebullition; (b) Simon's Manual of Chemistry, page 36; (c) *Filtration* is the mechanical separation of fluid and solids, by means of a *filter*, whose pores are large enough for liquid, but too small for the particles of solid, to pass through; (d) *Annealing* is a process of decreasing the brittleness of a substance by means of slow heating and cooling; (e) See Q. 38 to 41 (a).

807. Define (a) soap, (b) hydride, (c) specific heat, (d) haloid salt, (e) base. (*June, 1895.*)

807. (a) Simon's Manual of Chemistry, page 405; (b) A compound of hydrogen and one other element or radicle; (c) Simon's Manual of Chemistry, page 37; (d) A salt derived from a hydracid. See Q. 701. (e) Simon's Manual of Chemistry, page 92.

808. Define (a) malleability, (b) endosmosis, (c) dialysis, (d) cohesion, (e) chemical affinity. (*January, 1896.*)

808. (a) Simon's Manual of Chemistry, page 20; (b) page 31; (c) page 31; (d) page 18; (e) page 72.

809. Define (a) specific gravity, (b) valence, (c) analysis, (d) synthesis. (*May, 1896.*)

809. (a) Simon's Manual of Chemistry, page 25; (b) page 78; (c) page 91; (d) pages 91 and 92.

810. Define (a) incompatible, (b) hydrate, (c) sterilization, (d) destructive distillation. (*June, 1896.*)

810. (a) *Incompatible*, "of two substances or agents, not suitable for combination or simultaneous administration; also either one of two substances which are unsuitable for combination." (Duane's *Medical Dictionary.*) (b) Same as hydroxide. See Q. 707 to 718 (q). (c) Sterilization is the destruction of all living micro-organisms; (d) Simon's Manual of Chemistry, page 345.

811. Define (a) symbol, (b) formula, (c) element, (d) compound, (e) mixture. (*September, 1896.*)

811. (a) Simon's Manual of Chemistry, page 74; (b) pages 74 and 75; (c) page 71; (d) pages 71 and 75; (e) page 71.

812. Define (a) monad, (b) acid, (c) alkali, (d) element, (e) specific gravity. (*January, 1897.*)

812. (a) A monad is a univalent element or radicle. See Simon's Manual of Chemistry, page 79; (b) page 92; (c) See Q. 804 (b); (d) Simon's Manual of Chemistry, page 71; (e) page 25.

813. Define (a) atomic weight, (b) valence, (c) salt, (d) base, (e) analysis. (*April, 1897.*)

813. (a) Simon's Manual of Chemistry, page 74; (b) page 78; (c) page 95; (d) page 92; (e) page 91.

814. Define (a) porosity, (b) adhesion, (c) capillary attraction. (*June, 1897.*)

814. (a) Simon's Manual of Chemistry, page 28; (b) page 28; (c) page 29.

815. Define (a) hydrate, (b) anhydride, (c) molecule, (d) latent heat, (e) gravitation. (*September, 1897.*)

815. (a) See Q. 705 (n); (b) An *anhydride* is a substance which can combine with water to form an acid; thus, CO_2 is carbonic anhydride: $CO_2 + H_2O = H_2CO_3$, carbonic acid. See also Q. 765 to 770 (a). (c) Simon's Manual of Chemistry, page 75; (d) *Latent heat* is the heat absorbed by a body in passing from a solid to a liquid or from a liquid to a gaseous state, and which reappears as *sensible heat* when the process is reversed; (e) *Gravitation* is "the force by virtue of which the material particles of all bodies tend incessantly to approach each other." (Martin and Rockwell's *Chemistry and Physics.*)

816. Define (a) distillation, (b) sublimation, (c) destructive distillation. *Give an example of each process.* (*January, 1898.*)

816. (a) Simon's Manual of Chemistry, page 36; (b) page 36; (c) pages 345 and 360.

817. Define (a) acid, (b) base, (c) salt, (d) basic radicle, (e) isomerism. (*May, 1898.*)

817. (a) Simon's Manual of Chemistry, page 92; (b) page 92; (c) page 95; (d) A group of elements acting as a base. Simon's Manual of Chemistry, page 92. (e) page 343.

818. Define (a) molecule, (b) valence, (c) radicle, (d) chemical affinity, (e) graphic formula. Illustrate. (*June, 1898.*)

818. (a) Simon's Manual of Chemistry, page 73; (b) page 78; (c) page 96; (d) page 72; (e) page 339, and see Q. 756.

819. Define (a) chemistry, (b) molecule, (c) physical change, (d) chemical change. (*January, 1899.*)

819. (a) Simon's Manual of Chemistry, page 73; (b) page 73; (c) page 17; (d) page 17.

820. Explain the following terms: (a) chemical reaction, (b) alkaline reaction, (c) *Define* specific gravity. (*May, 1899.*)

820. (a) Simon's Manual of Chemistry, page 91; (b) A substance is said to have an alkaline reaction when it will turn red litmus blue; (c) Simon's Manual of Chemistry, page 25.

821. Define (a) atom, (b) molecule, (c) element, (d) compound, (e) chemistry. (*June, 1899.*)

821. (a) Simon's Manual of Chemistry, page 73; (b) page 73; (c) page 71; (d) pages 71 and 75; (e) page 73.

822. Define (a) matter, (b) crystal, (c) amorphous state, (d) malleability, (e) distillation. (*September, 1899.*)

822. (a) Simon's Manual of Chemistry, page 17; (b) page 19; (c) page 20; (d) page 20; (e) page 36.

823. Define and illustrate osmose. (*September, 1899.*)

823. Simon's Manual of Chemistry, page 31.

824. Define (a) radicle, (b) anhydride, (c) compound. *Give an example of each.* (*May, 1900.*)

824. (a) Simon's Manual of Chemistry, page 96. Example NH_4. (b) See Q. 815 (b). (c) Simon's Manual of Chemistry, pages 71 and 75. Example, H_2SO_4.

825. Define (a) hydrate, (b) valence, (c) basicity, (d) putrefaction, (e) decomposition. (*June, 1900.*)

825. (a) See Q. 705 (n); (b) Simon's Manual of Chemistry, page 78; (c) The number of replaceable hydrogen atoms in an acid. Simon's Manual of Chemistry, page 92. (d) pages 347 and 348; (e) By *decomposition* is meant the separation of a compound into its parts (by heat, electricity, light, chemicals, etc.). The term is often used of

the putrefaction of organic compounds. Simon's Manual of Chemistry, page 347 and 348.

826. Define (a) molecular weight, (b) specific gravity, (c) valence, (d) allotropism, (e) synthesis. (*May, 1901.*)

826. (a) Simon's Manual of Chemistry, page 74; (b) page 25; (c) page 78; (d) page 103; (e) pages 91 and 92.

827. Define and illustrate (a) *chemical affinity,* (b) *osmose,* (c) *alkali,* (d) *anhydride,* (e) *combustion.* (*June, 1901.*)

827. (a) Simon's Manual of Chemistry, page 72; (b) page 31; (c) See Q. 810 (b); (d) See Q. 815 (b); (e) Simon's Manual of Chemistry, page 114.

828. Mention the substances used for disinfection after the prevalence of contagious disease and explain their action. (*January, 1898.*)

828. Sulphur dioxide. Simon's Manual of Chemistry, page 145. Note that the presence of moisture is essential for its action. Formaldehyde and paraformaldehyde, page 373. Chlorine, page 164.

PHYSICS.

829. (a) *Distinguish between physics and chemistry.* (*April, 1894.*)

830. (a) *Distinguish between chemical and physical changes of matter.* (b) *Give examples of each.* (*November, 1894.*)

831. (a) *Define* chemical action, physical action. (b) *Give example of each.* (*January, 1898.*)

832. (a) *What is the difference between a mechanical and a chemical action?* (*March, 1893.*)

833. (b) *Describe two experiments showing the difference between chemical and mechanical action.* (*April, 1895.*)

829 to 833. (a) "Physics is that branch of the natural sciences which especially treats of the properties of terrestrial matter; of the forces governing it, and of the phenomena pertaining to it. It treats of changes in the *state* of matter, while chemistry treats of changes in *identity.*" (Martin and Rockwell's *Chemistry and Physics.*) And see Simon's Manual of Chemistry, pages 17 and 73. In Q. 832 mechanical = physical. (b) "*The distinction between physical and chemical change:* An example of this distinction is afforded by mixing yellow sulphur and black iron-filings. As a result, a mixture of a greenish-yellow color is obtained. By examining this mixture with a microscope each particle of iron and sulphur can be identified by sight, and a separation can be made by using a magnet, the particles of iron being gathered up by it, leaving the sulphur, which is not attracted, thus giving us what we started with—iron and sulphur. The change here was one of color, resulting from mixing a yellow substance with a black one; but the iron and sulphur in the

mixture are the same as before the mixing. Such a change as this is merely a change in state, a physical change, and such a mixture would be called a *mechanical mixture.* If these iron and sulphur powders be mixed together, placed in a test-tube, and heat applied, we see a different kind of a change. The sulphur will become soft, pasty, and finally liquid; then the bottom of the mass will begin to glow, getting red-hot; the glow then extends throughout the mixture, even *after* the flame has been removed, and the entire mixture becomes red-hot from heat generated in itself. This is evidently a new kind of phenomenon. On heating the tube and removing the contents we obtain a homogeneous mass in which we cannot recognize the original particles of yellow sulphur or gray-black iron, nor will the magnet attract the latter. The change here has evidently been one affecting the nature of the substances, and is called a *chemical change.*" (Martin and Rockwell's *Chemistry and Physics.*)

834. (a) *Define chemistry.* (b) *Mention the three states of matter.* (*June, 1902.*)

835. (b) *Name the various states in which matter may exist.* (*September, 1893.*)

836. Explain the difference between (c) *a solid and* (d) *a liquid.* (*November, 1892.*)

837. (e) *What is a gas?* (*November, 1892.*)

838. By what forces can (f) *a solid be changed into a liquid or a gas,* (g) *a gas be changed into a liquid or a solid?* (*January, 1895.*)

834 to 838. (a) Simon's Manual of Chemistry, page 73; (b) page 18; (c) pages 18 and 20; (d) page 21; (e) page 21; (f) By heat, or diminution of pressure; (g) By cold, or increased pressure.

839. Prove the indestructibility of matter. (*April, 1895.*)

840. Defend the statement, "Matter is indestructible." (*January, 1897.*)

839 and 840. Simon's Manual of Chemistry, page 32.

841. Define and give examples of the three varieties of attraction. (*May, 1895.*)

842. Explain the difference between cohesion and adhesion. (*June, 1893.*)

841 and 842. The three varieties of attraction are: (a) gravitation, (b) cohesion, and (c) chemical affinity; for (a) see Simon's Manual of Chemistry, page 25; for (b) see page 18 (adhesion, page 28); for (c) see page 72.

843. (a) *Why is capillary attraction so called?* (b) *Mention some familiar examples.* (*June, 1896.*)

843. (a) The term is derived from the Latin *capillaris* (= like a hair), which itself is derived from *capillus* (= a hair); and capillary attraction is so called because it is best exhibited in fine tubes like hairs; (b) Simon's Manual of Chemistry, page 29.

844. What are the general methods by which crystals may be obtained? (*April, 1895.*)

845. State the conditions favorable to crystallization. (*June, 1899.*)

844 and 845. Simon's Manual of Chemistry, page 19.

846. What is an amorphous substance? What are isomorphous substances? (*May, 1897.*)

846. Simon's Manual of Chemistry, page 20.

847. (a) *Define* specific gravity. (b) *Give a method of determining the specific gravity of a solid substance insoluble in water.* (*September, 1898.*)

848. (c) *How do you determine the specific gravity of a liquid?* (*November, 1892.*)

849. (d) *What is the unit of comparison of determining the specific gravity of liquids?* (e) *of gases?* (*April, 1894.*)

850. (f) *Give a description of a hydrometer.* (*January, 1892.*)

851. (a) *What is understood by specific gravity, and* (g) *what precautions are advisable in the use of the urinometer?* (*July, 1893.*)

847 to 851. (a) Simon's Manual of Chemistry, page 25; (b) *1. If the substance is heavier than water,* (1) weigh the substance in air, say it = x; (2) weigh it in water, say it = y. Then specific gravity of that substance $= \frac{x}{x-y}$.

Example: A body weighs in air 56 ounces; it weighs in water 49 ounces; its specific gravity is $\frac{56 \text{ ounces}}{(56-49) \text{ ounces}} = \frac{56 \text{ ounces}}{7 \text{ ounces}} = 8$. (Note, SPECIFIC GRAVITY = 8; NOT 8 OUNCES.) *2. If the substance is lighter than water,* "a weight is generally used as a sinker. The substance is first weighed in air; then the sinker is weighed in both air and water, and then the substance and sinker are weighed together—first in air and then in water. The specific gravity can then be calculated as follows:

Example: A piece of wax weighed in air = 133.7 ounces
The wax and sinker weighed in air = 187.7 ounces
The wax and sinker weighed in water = 38.8 ounces

Weight of volume of water equal to that of wax and sinker = 148.9 ounces

Weight of sinker in air = 54.0 ounces
Weight of sinker in water = 44.4 ounces

Weight of an equal volume of water = 9.6 ounces

Weight of volume of water equal to that of the wax alone = (148.9—9.6) ounces = 139.3 ounces.

$\therefore$ Specific gravity of wax $= \frac{133.7 \text{ ounces}}{139.3 \text{ ounces}} = 0.9598$.

(Collins and Rockwell's *Chemistry and Physics.*)

(c) Simon's Manual of Chemistry, page 26; (d) Distilled water at a temperature of 60° F.; (e) (1) air and (2) hydrogen; (f) Simon's Manual of Chemistry, pages 26 and 561; (g) Cool the urine to 60° F. See that the urinometer

does not touch the sides of the containing vessel. Read the highest point to which the urine reaches by capillarity.

852. Explain the differences between the Fahrenheit, Centigrade, and Réaumur thermometers. (*September, 1895.*)

853. Explain the difference between the Fahrenheit, Réaumur, and Celsius thermometers. (*January, 1894.*)

852 and 853. Simon's Manual of Chemistry, page 37; and add the Réaumur thermometer has the freezing point at 0° and the boiling point at 80°; hence, 180° F. = 100° C. = 80° R. The Celsius thermometer is the centigrade.

854. What is the relation between atomic weight and specific heat? (*May, 1897.*)

854. Simon's Manual of Chemistry, pages 83 and 84.

855. (a) *Give the boiling point* (*Fahrenheit*) *of water, of alcohol, of ether, of mercury.* (*June, 1896.*)

856. (a) *What is the boiling point* (*Fahrenheit*) *of water, of alcohol, of mercury?* (*June, 1897.*)

857. (b) *What is freezing?* (a) *State the* (*Fahrenheit*) *freezing point of water, of alcohol, of mercury.* (*May, 1897.*)

855 to 857.

(a)	Boiling point. (Fahrenheit.)	Freezing point. (Fahrenheit.)
Water	212°	32°
Alcohol	172°	—202°
Ether	98.6°	
Mercury	675°	—40°

These figures are from Simon's Manual of Chemistry.

(b) *Freezing* is the conversion of a liquid into the solid state.

858. What is the fever thermometer? How is it made and graded? (*June, 1893.*)

858. "This is a maximum recording thermometer which gives great delicacy of indications over a short range of temperature, usually 94° F. to 112° F. Delicacy is at-

tained by having a very small capillary tube and a large bulb of thin glass. By making a constriction in the tube near the bulb, the column of mercury is always broken when it begins to contract: consequently it remains at the same level in the tube and thus records the maximum temperature. The constriction interferes with the passage of mercury sufficiently to gain this effect, but cannot stop its expansion." Martin and Rockwell's *Chemistry and Physics*.

859. What chemical change takes place when a photographic plate is exposed to daylight? (*September, 1898.*)

860. Give the chemistry of photography. (*April, 1895.*)

859 and 860. "Photography depends on the fact that light alters the chemical nature of certain substances. Silver salts are so affected by light that solutions of chemicals, known as *developers*, reduce them to the metallic state. A plate sensitized with silver salts is exposed in a camera, and the rays which produce the image on it also affect these salts. By the action of a developer the affected salts are deposited as metallic silver on the plate, while the unchanged salts remain soluble in a solution of hyposulphite of sodium. The image produced by the metallic silver is known as a *negative*, because it is the reverse of the conditions which caused it. Wherever the brightest rays from bright parts of objects fall the silver salts are most affected and more silver is deposited; consequently this part of the negative is darker, while those parts are lighter on which fell the less brilliant rays from darker parts of the objects. Other methods depend on the decreased solubility of certain substances after being exposed to light. . . . . After a plate has been exposed in the camera it is placed in the developer—for instance, a solution of pyrogallic acid—till enough silver has been deposited to depict the images clearly. It is then placed in a solution of hyposulphite of sodium, which dissolves out all the unchanged silver salts and stops further development. It is kept in

the 'hypo' solution until it becomes everywhere translucent and is then washed very thoroughly in water and dried, when it is ready for printing." (Martin and Rockwell's *Chemistry and Physics.*)

861. Define electricity. (*March, 1893.*)

861. Simon's Manual of Chemistry, page 57.

862. Describe an electric battery, and explain the operation of the chemicals used. (*June, 1900.*)

863. Describe the method of producing an electric current by chemical action. (*September, 1897.*)

864. Describe a galvanic cell. State the chemical changes produced within a galvanic cell while in action. (*January, 1898.*)

862 to 864. Simon's Manual of Chemistry, pages 59, 60 and 61.

865. What is the faradic current? How is it produced? (*April, 1899.*)

865. Simon's Manual of Chemistry, pages 63 and 64.

866. Give (a) *the uses,* (b) *mode of application,* (c) *advantages, and* (d) *disadvantages of faradism as applied to medicine.* (*January, 1896.*)

866. Faradism here means the employment of the induced current. (a) The *uses* are (1) for *diagnosis:* to detect alterations of irritability or sensibility; to aid in distinguishing forms of paralysis; to detect malingering; as a final test of death. (2) As a *therapeutic agent:* as a stimulant and counterirritant; as a sedative and antispasmodic; to promote general nutrition; to quiet nervous agitation; to procure natural sleep without drugs; to provide passive exercise of muscles. (From McGregor Robertson, and Monell.)

(b) "Faradization may be applied *generally.* One good way of doing this is to seat the patient in a chair, stripped to the waist, and his bare feet on a metal plate to which one pole is attached. The operator has the other pole connected to a sponge electrode, which he applies to various

parts of the patient's body as desired. . . . *Localized* faradization is the phrase used by Duchenne when the two electrodes are applied near one another, so as to confine their action to groups of muscles, or single muscles, or nerves, or limited regions of the body. Again, a muscle may be faradized *directly*, when the moist electrodes are so applied that the current is sent to the muscle substance itself, or *indirectly* when the stimulus is applied to the nerve which supplies the muscle. . . . . A feebler current will produce contraction of a muscle when applied to its motor nerve than when applied to its own substance. Certain places can be marked on the skin, from which an induced current, applied by a moist sponge electrode, can reach the motor nerves of separate muscles or groups. These are termed *motor points.*" (McGregor Robertson's *Physiological Physics.*)

(c), (d) *Advantages and disadvantages:* Faradism has no chemical, thermic, or electrolytic action; local applications give less trouble and require less attention to detail than galvanism.

867. Explain the difference between a galvanic and a faradic current. (*January, 1893.*)

868. What is the difference between faradism and galvanism? (*September, 1896.*)

867 and 868. The galvanic current is constant and continuous; it always flows in the same direction; it has decided chemical and thermal effects.

The faradic current, or induction current, is a rapid succession of waves or momentary impulses; the direction is not constant; the chemical and thermal effects are almost imperceptible.

The brain and nerves of special sense respond more quickly and decidedly to the galvanic current than to the faradic.

869. Explain the method of producing the X or Roentgen rays. (*April, 1897.*)

869. Simon's Manual of Chemistry, page 69.

870. (a) *Describe the incandescent electric light, and* (b) *explain its uses as an aid to diagnosis in medical and surgical practice.* (*June, 1897.*)

870. (a) "The incandescent light depends on the principle that a strong current, when passing through a wire of small conductivity, raises its temperature to the point of incandescence. The lamp consists of a globular glass bulb, hermetically sealed and exhausted of air by a Sprengel pump. Through the base pass two platinum wires fused in the glass. To these is attached a loop of carbon, which becomes incandescent when the current passes through it. The air is exhausted to prevent combustion of the carbon. These lamps give off very little heat." (Martin and Rockwell's *Chemistry and Physics.*) (b) 1. As a means of ordinary illumination. 2. Also, on account of the very little heat given off, a small incandescent electric light can be introduced into some of the cavities of the body, for visual examination; this has been done in the case of the bladder, urethra, rectum, larynx, mouth, vagina. 3. It is also used for transillumination—*e. g.*, of the stomach (by means of the gastrodiaphane); also of the antrum of Highmore, and the frontal sinus.

APPENDIX.

QUESTIONS ASKED JANUARY, 1903.

871. Define and illustrate (a) *specific gravity,* (b) *saturated solution,* (c) *emulsion.*

871. (a) See Q. 820 (c); (b) "A solution containing as much of a dissolved substance as it is capable of dissolving is said to be *saturated.*" (Witthaus' *Manual of Chemistry.*) (c) See Q. 384 (c).

872. Write the formula of (a) *ammonium chloride,* (b) *acetic acid,* (c) *iodoform,* (d) *argentum nitrate,* (e) *cane-sugar.*

872. (a) See Q. 244 (d); (b) See Q. 748 (g); (c) See Q. 301 (d); (d) See Q. 236 (f); (e) See Q. 406 to 417 (c) (2).

873. What is (a) *an acid,* (b) *an alkaloid? Illustrate.*

873. (a) See Q. 697 to 706 (c); (b) See Q. 443 to 452 (a).

874. Describe the halogen elements.

874. See Q. 85 to 90.

875. How is hydrochloric acid generally prepared? Give the properties of hydrochloric acid.

875. See Q. 69 and 70.

876. Define combustion. State the result of combustion.

876. Simon's Manual of Chemistry, page 346.

877. A person voids daily 50 ounces of normal urine; give the approximate quantity of each *of the following ingredients voided:* (a) *urea,* (b) *uric acid,* (c) *total solids,* (d) *water.*

877. See Q. 490; and 486 to 488.

878. How may the presence in urine of each *of the following be detected:* (a) *albumin,* (b) *sugar?*

878. (a) See Q. 527 to 534; (b) See Q. 539 to 548.

879. What is reduced iron (ferrum redactum)? State how reduced iron is obtained and mention its uses.

879. See Q. 196. "It is used solely in anæmia." (Hare's *Practical Therapeutics.*)

880. Give the gross chemistry of the sugars.

880. Simon's Manual of Chemistry, pages 409 to 412.

881. Give the chemical reaction in the mixing of a Sedlitz powder.

881. See Q. 799 and 800 (d).

882. (a) *Describe collodion and* (b) *state its uses.*

882. (a) Collodion is a solution of pyroxylon or gun-cotton in a mixture of alcohol and ether; it is a clear, syrupy fluid and has an odor of ether. (b) See Q. 421 and 422.

883. Give a test for the detection of alum in baking powder.

883. "Alum is tested for (in baking powder) by burning a small quantity of the sample to an ash, which is then treated with boiling water and filtered. If on the addition of ammonium chloride to the filtrate a flocculent precipitate is formed, this will indicate the presence of alum in the sample." (*Ref. Handbook of the Med. Sciences,* vol. iv. p. 180.)

884. State how to determine whether a given white powder is calomel or corrosive sublimate.

884. See Q. 257 to 263.

885. Give the chemical changes occurring when potassium is placed on water.

885. See Q. 226.

QUESTIONS ASKED MAY, 1903.

886. (a) *Define photography.* (b) *Give the chemistry of photography.*

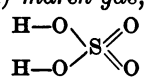
886. (a) "Photography is the art of making a permanent reproduction of any object by throwing the image of the latter upon a plate coated with silver salts or other substances readily decomposed by light, rendering visible the image thus obtained by treatment with reducing agents (developers) and fixing it by treatment with some agent which removes the salt which has been unacted upon." (Duane's *Medical Dictionary.*) (b) See Q. 860.

887. Give the formula and name of the product that results when phosphorus is burned in dry air.

887. If phosphorus is burned in a *limited* supply of dry air, phosphorus trioxide, P_2O_3, is formed; if phosphorus is burned in an *excess* of dry air, phosphorus pentoxide, P_2O_5, is formed.

888. Write the graphic formula of (a) *sulphuric acid,* (b) *water,* (c) *nitric acid,* (d) *marsh-gas,* (e) *calcium hydrate.*

888. (a)



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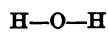

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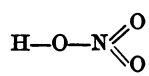

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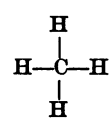

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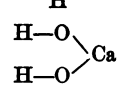

889. Describe the relations of oxygen to combustion and to life.

889. See Q. 21, 12 (g), and 19 (c).

890. Give the Fahrenheit and the centigrade degree of (a) *the freezing point,* (b) *the boiling point.*

890. Simon's Manual of Chemistry, page 37.

891. (a) *What mineral acids are incompatible with mercurous chloride?* (b) *Give the formula and synonyms of mercurous chloride.*

891. (a) Simon's Manual of Chemistry, page 246; (b) page 246.

892. (a) *Describe the appearance of urine containing bile and* (b) *give tests for the detection of bile in urine.*

892. (a) Simon's Manual of Chemistry, page 582; (b) See Q. 549 and 550.

893. (a) *Give the treatment of corrosive sublimate poisoning.* (b) *Mention an antidote to arsenic poisoning and state how this antidote is prepared.*

893. (a) See Q. 273 to 275; (b) See Q. 175 to 178.

894. Define (a) *fermentation,* (b) *decomposition,* (c) *putrefaction.* (d) *What conditions are necessary to putrefaction?*

894. (a) See Q. 477 to 484 (c); (b) See Q. 477 to 484 (e); (c) See Q. 477 to 484 (d); (d) See Q. 484 (h).

895. Mention and describe three *allotropic forms of carbon.*

895. See Q. 191 to 193.

896. Give the general definition of an ether. How is sulphuric ether obtained?

896. See Q. 429 (b), and 325 to 327.

897. Give the composition of (a) *cane-sugar,* (b) *grape-sugar,* (c) *starch.*

897. (a) Simon's Manual of Chemistry, page 411; (b) page 409; (c) page 413.

898. During respiration what chemical changes take place in (a) *the air,* (b) *the blood?*

898. See Q. 367.

899. Give a test for the detection of hydrocyanic acid in solution.

899. Simon's Manual of Chemistry, page 423.

900. Complete the following equations:

(a) $CH_3Cl + HCl + Zn =$

(b) $2FeCl_3 + H_2S =$

900. (a) $CH_4 + ZnCl_2$

(b) $2FeCl_2 + 2HCl + S$.

QUESTIONS ASKED JUNE, 1903.

901. Give the symbol, valence, and a principal compound of each of 10 elements.

901. For symbol and valence see Q. 664; for a principal compound see Simon's Manual of Chemistry, pages 111 to 267.

902. Define and illustrate (a) *mixture,* (b) *compound,* (c) *radicle,* (d) *salt,* (e) *endosmosis.*

902. (a) Simon's Manual of Chemistry, page 75; (b) pages 71 and 75; (c) page 96; (d) page 95; (e) page 31.

903. State the normal reaction of (a) *urine,* (b) *saliva,* (c) *blood,* (d) *synovial fluid,* (e) *tears.*

903. (a), (b), (c) and (e) See Q. 585 to 589; (d) The normal reaction of synovial fluid is alkaline.

904. Describe a method of preparing (a) *hydrochloric acid,* (b) *nitric acid,* (c) *iodoform.*

904. (a) See Q. 69 and 70 (d); (b) See Q. 144 to 147; (c) See Q. 300 to 304 (b).

905. Describe the microscopic appearance of (a) *uric acid,* (b) *triple phosphates.*

905. (a) Simon's Manual of Chemistry, pages 588 and 589; (b) pages 590 and 589.

906. (a) *Give a typical example and* (b) *state the principal ingredients of* each *of the following mineral waters: saline cathartic, alkaline, sulphurous.*

906. (a) See Q. 47; (b)

	Principal Ingredients.
Saline cathartic	Chlorides and Sulphates of Sodium, Magnesium, Potassium.
Alkaline	Carbonate and bicarbonate of Sodium, Potassium, Calcium, Lithium, and Magnesium.
Sulphurous	Sulphureted hydrogen or metallic Sulphides.

907. (a) *Give the chemical properties of fluorin.* (b) *Mention the uses of hydrofluoric acid.*

907. (a) Simon's Manual of Chemistry, page 172; (b) See Q. 53 and 54 (b).

908. Mention the chemical reason for the use of lithia and its salts in cases of uric acid diathesis.

908. See Q. 592, 593 and 213 (c).

909. Give the formula, preparation and uses of carbolic acid.

909. See Q. 424 and 425.

910. Give the characteristics of (a) *diabetic urine,* (b) *nephritic urine,* (c) *cystitic urine.*

910.

		Quantity.	Sp. Gr.	Urea.	Albumin, Casts, Sugar, etc.
(a)	Diabetes insipidus.	Enormously increased.	Low.	Increased.	Contains neither.
	Diabetes mellitus.	Much increased.	High.	Increased.	Contains sugar; and sometimes β-oxybutyric and diacetic acids; urine has a sweetish odor.
(b)	Acute parenchymatous nephritis.	Much diminished.	High.	Diminished.	Albumin present, also casts (hyaline, blood, epithelial).
	Chronic parenchymatous nephritis.	Diminished.	Variable.	Diminished.	Albumin abundant, and casts of all kinds.
	Chronic interstitial nephritis.	Increased.	Low.	Diminished.	Albumin scanty or absent; few hyaline casts.
(c)	Cystitis.	Pus present: generally, too, albumin, blood, epithelium, triple phosphate crystals. Bacteria nearly always found.			

911. Give equations showing a mode of preparing (a) *H*, (b) *O*, (c) *AgCl.*

911. (a) See Q. 2; (b) See Q. 10 to 15 (d); (c) See Q. 289 (a).

912. Express the following in apothecaries' weight and measure:

Ammonii carb., 5 grammes.
Syr. aurantii, 60 c.c.
Aquæ destil., ad 120 c.c.

912. Ammonii carb., gr. lxxx.
Syr. aurantii, ℥ij.
Aquæ destil., ad ℥iv.

913. What is coal oil? Mention the principal derivatives of coal oil used in medicine.

913. See Q. 292.

914. Define fermentation, putrefaction, combustion, decay.

914. See Q. 477.

915. Complete the following equations:

(a) $C_2H_5NO_3+KOH=$

(b) $CaCO_3+2HCl=$

915. (a) $KNO_3+C_2H_5OH$.

(b) $CaCl_2+CO_2+H_2O$.

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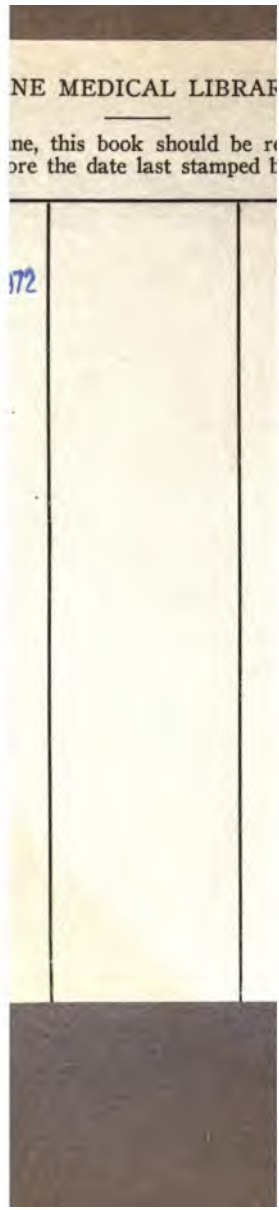

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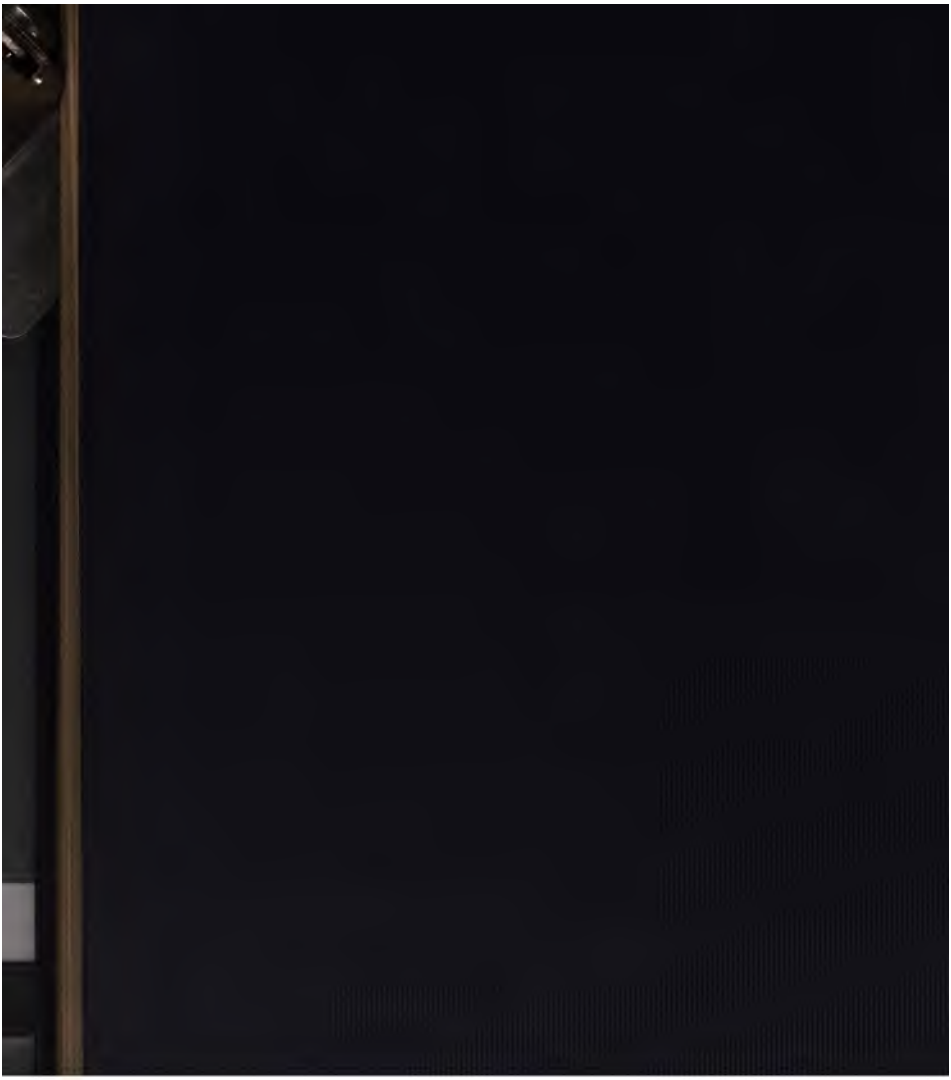
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